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## MEANING OF THE RECENT UNITED STATES PATENT DECISION.

*By Park Benjamin.*

ANY one interested in a paying enterprise based upon the protection afforded by a patent naturally desires that the lifetime of that patent shall be as long as possible. When the patent underlies a great monopoly, the returns from which are huge and increasing, then, as may well be imagined, the last years of the patent term are regarded as much more valuable than the earlier ones; and the desire not to be deprived of protection at such a time becomes increased. When there is a number of such monopolies all similarly circumstanced, the aggregate bulk, so to speak, and the combined force of these several desires gets excessive; and, when such a deprivation or limitation appears imminent, then it is easily anticipated that appeals possessing great momentum will be made to legislature and court, —the first so to make or amend, the second so to construe or interpret, law as to avert the impending disaster.

The decision in the famous Bate refrigerating process case recently rendered by the supreme court of the United States is a consequence of the conditions above outlined. Several distinguished inventors had made inventions of merit. They had complied with all legal requirements and had secured patents of the United States, apparently granting them protection for the statutory term of 17 years. They had also obtained foreign patents for the same devices. But for various causes —sometimes purely fortuitous and beyond their control, such as unlooked-for delays in one patent office or especial expedition in another —it had come to pass that these foreign patents had been granted to them *before* the American ones.



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*Hinc illæ lachrymæ.* From this simple happening apparently grew all the trouble, and the appeal to the highest tribunal in the land.

The real source of the difficulty lies, however, not in the circumstance, but in the law; and more particularly in Section 4887 of the Revised Statutes* of the United States, which provides that, if you choose to apply for both American and foreign patents, the American patent will be granted on the condition that, if you obtain the foreign patent *first*, your invention shall be free to the American people whenever, by reason of the expiration of the foreign patent, it becomes free to people abroad. Observe that the person here aimed at was the foreign, and not the American, inventor; and the intention was to secure for our own people the free use of the foreigner's invention as soon as his own compatriots got it. In other words, as the diplomatists say, we claimed for ourselves the benefits of the "most favored nation."

But the intention of the law-makers and the effect of the law have not at all comported. The statute has proved a legislative boomerang which has recoiled upon ourselves, and its principal effect is and has been to limit the lifetime of the American patents of our own inventors to the often much shorter lifetimes of their previously-granted foreign patents; and, since many of these American patents lie at the foundation of great enterprises in this country, the losses to the owners and promoters thereof, incident to such limitation, are great and far-reaching. These are the more special circumstances surrounding the recent appeal to the supreme court.

As this troublesome statute existed in the Patent Act of 1870, and, in fact, became crystallized in the Revised Statutes of the United States before most of the patents affected at the present time were applied for, it may be urged that there is no apparent ground for complaint by the parties injured by it. They were not compelled to seek foreign patents, or to prosecute the latter so as to cause them to be granted at a date earlier than that of their American patents. Seemingly they chose to do this with the law before them, and therefore voluntarily placed themselves under the conditions which it imposed as the sequence of their act. But, on the other hand, it must be remembered that, at the period when perhaps most of the important patents now limited were sought, the great era of electrical development in this country had only just begun. People were then rushing

* R. S., Sec. 4887. No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. *But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent*, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than 17 years.

in to get patents, chiefly for electric-lighting apparatus. Then came the invention of the telephone, which created still more intense interest in electrical subjects. A little later followed the storage battery, with all the glowing promises made concerning it. And thus, for several years, the rivalry among inventors in the electrical field was intense, their activity unprecedented, and the supposed rewards so great and so near at hand that it seemed that any delay in the securing of protection for new devices might well result in the loss of them to others. There was little time or desire, in those days, to discuss limitations of the patent grant or the relations of various patent grants to one another. To secure immediate protection; to issue stock and sell it, and float companies, and realize profits,—these were the all-engrossing matters. To counsel caution merely evoked an answer picturing the immense gains to be secured at once from the invention, and expressing an entire willingness to leave the disastrous to-morrow to take care of itself.

"What do I care?" said one sanguine genius to me, after I had warned him of the effect of a foreign patent of but 5 years' duration, which he insisted upon obtaining. "Before that 5 years is up, I shall have made all I want of it, and there will be half a dozen generations of stockholders, in and out of the company, with their piles all made before that time comes. Let the people who own the thing then take care of themselves."

That, of course, was an extreme case, but, to a certain extent, it is typical. In the course of years the people who ultimately inherited these things found that they did have to "take care of themselves." Many of the inventions had long since gone out of the hands of individuals and into those of great corporations. The question of a man's right to his little profits for a few years more or less often became magnified into whether the public should continue to pay millions for the benefit of huge monopolies.

So the vast power of the latter began to work for their own salvation. Again and again they importuned for the repeal of the objectionable statute. Five bills were introduced into the fifty-third congress, all looking to the amendment of the law and all retroactive in their character. The effort was unavailing.

Meanwhile recourse was had to the courts, where alleged infringers pleaded the law in their defence, and from 1882 onward every effort was made to induce the judges to construe the statute to mean that the foreign patent, in order to have its limiting effect, must bear a date of grant prior to the date of *application* for the American patent; so that it would then be nugatory in the great majority of cases where the foreign patent had been granted after the date of application for the

American patent, but before the date of grant thereof. The courts remained obdurate. In an unbroken series of decisions for nearly 13 years they construed Section 4887 by the plain import of its language.

As time went by, the immense growth of the electric corporations and the popular belief in the magnitude of their profits united to stimulate the public desire for free competition. Attempts to break down the incandescent-light patents of Mr. Edison failed. It was discovered that the expiration of the two fundamental telephone patents offered no certain release from the exactions of the controlling monop oly. After a sleep of 14 years in the patent office, the so-called Berliner patent was issued, and it was announced that this patent, together with others granted to Edison for a speaking telegraph, "covered fundamental inventions and embraced all forms of microphone transmitters and carbon telephones." Yet, if the statute meant what it plainly said, these patents had lapsed. But the corporations persistently asserted that the United States supreme court, whenever it should come to consider the question, would reverse the rulings of the lower courts and interpret Section 4887 favorably to their view of it. This was sufficiently potent seriously to check the growth of competing enterprises, although the effect of the doubt on the corporations themselves could be read easily enough in their stock quotations.

Affairs had become exacerbated when an equity suit, in which the precise matter at issue was involved, reached the United States circuit court of appeals in New York. On December 1, 1876, one John J. Bate applied for a United States patent for a process of preserving meat during storage and transportation. The patent was granted to him on November 20, 1877. In the interval two foreign patents were also granted to him, which expired before the end of the term of his American patent. Bate sued some butchers in New York for infringement. In defence it was insisted that, although Bate's patent appeared on its face to be still unexpired, nevertheless it had expired by reason of the expiry of the earlier foreign patents, and before the beginning of the suit; and hence that the court was without jurisdiction. The court sustained this plea and dismissed the case. When it came up to the circuit court of appeals, that tribunal turned to the supreme court of the United States for advice, and asked it to decide "whether the invention for which the United States patent aforesaid was issued to said John J. Bate had been 'previously patented in a foreign country' within the meaning of those words in Section 4887 of the Revised Statutes, and whether the patent expired under the terms of said Section before the expiration of the term of 17 years from its date."

The corporations, it is needless to remark, arranged to have this question argued before the supreme court in the most elaborate manner

and by the ablest lawyers. Hence the rights of Mr. Bate were represented by an array of distinguished legal talent, headed by the chief counsel of the American Bell Telephone Company, and the rights of the butchers who were alleged to have pirated the refrigerating process were ostensibly defended by another array of legal luminaries equally impressive. Besides these, special telephone interests hostile to the Bell monopoly were permitted to send their representatives to join in the opposition. The briefs and arguments say very little about Bate and his invention, but Section 4887 is discussed to the vanishing point.

It is not necessary here to review the contentions of those who pulled against the stream and against the stalwart strokes of the opposing forces who sedulously backed water and sent the boat along with the flood, as it was inevitably bound to go. The gist of the whole matter and of the supreme court's decision may be stated in a very few words. The corporations, as I have said, wanted the court to read into the statute the words "prior to his application," so that the law would make a foreign patent limit an American one only when granted *before the American patent was applied for.* The court declined to insert, by any judicial construction, those words in the law; for to do so, it said, would be to legislate, and not to interpret the statute.

And so the law remains just as it has always been since it was placed upon the statute-book, with the meaning attached to it which everybody has given, except those who have been interested in reading it in a different way.

The whole effect of this final settlement of the question cannot be safely estimated, because no one knows all of the patents which may be influenced. In New York the existing injunctions under the Edison incandescent lamp-patents have already been dissolved, and this course will undoubtedly be followed in all other parallel instances. The Berliner and early Edison telephone patents cease to be bugbears to telephone inventors.

But certainly a new crop of old questions will now revive, and the patent lawyers are busily furbishing their reminiscences of them in expectation of future frays. For example, since an invention "patented in a foreign country" is the limiting cause, what does "patented" strictly signify? Patented in the sense of United States law, or patented in the sense of foreign law, or merely *prima facie* patented. And if the thing *prima facie* patented turns out never to have been actually and validly patented at all, what becomes of the later United States patent assumedly rendered void by the apparent foreign patent which *ab initio* had no legal existence?

Then there is the accidental suffering argument. The American patent is allowed. The inventor, taking advantage of the 6 months'

delay, endeavors to arrange that the American patent shall issue here and a foreign patent be filed abroad on the same day, thus seeking to prevent one patent having any effect on the other. But, through some accident, his nicely-laid plan fails. His letters of advice miscarry; his money draft is carelessly made out; snow blocks the railway and the mails are late, or the telegraph wires are down; a clerk somewhere takes an unexpected holiday; his cable despatch is confused,—any of these things may put the granting of the foreign patent ahead of that of the American patent, and the mischief is done. *Ergo*, the law is intolerable.

Or, to make matters even worse, there is the doubt as to whether the earlier-granted foreign patent which limits must be that of the American inventor, or may be that of anyone else. The statute contains no words of restriction whereby, in both cases, the patentee is to be one and the same person. Indeed, to insert such words now seems to be as much a legislative act as that of adding the other words which the supreme court refused to read into it. If this be true, woe betide the inventor who incautiously reveals the subject of his American application! There is nothing to prevent his enemy or competitor, learning thereof, from obtaining immediately an Italian patent which will terminate in 1 year, and thus the unfortunate applicant in the United States, who may be delayed in the patent office by its endless red-tape for more than 12 months, may find his American patent dead, killed by his enemy's earlier Italian patent before he ever gets it from the patent office.

So the American patentee, until congress shall relent and come to his relief, is left by the supreme court "between the devil and the deep sea." If he has his American patent granted first, and it gets over to Germany or England, for example, his patents in those countries, subsequently sought, will fall because of the so-called prior introduction of knowledge into the realm. If he has his foreign patents granted first, he may seriously reduce the term of his American patent. Of course, there are ways of managing these things by dint of prudent foresight, quick and astute correspondents, and the Atlantic cables, so that the risks are reduced; and, in reality, the dangers to an inventor who keeps his secrets and applies for his foreign patents at the proper time and in the proper manner are much less formidable than they appear.

It is perfectly true that congress is omnipotent in these matters, and can impose any conditions or terms upon the inventor which it sees fit as a condition precedent to giving him his patent; but the whole spirit and sense of our patent system favors the utmost liberality and consideration to the inventive genius of the nation, and is sternly

against hampering or harassing it in any way. For this reason every attempt to impose recurring taxes upon patentees, or to compel them to "work" their devices, under penalty of forfeiture of patent, after the fashion of many foreign countries, has failed; and even the perennial grab of the Western Granger at the four-million-dollar surplus now to the credit of the patent office in the United States treasury, for school purposes and other improper diversions of it, regularly comes to naught.

There can be little doubt that Section 4887 does not serve any beneficial purpose, if it is not altogether mischievous in its effect. Public opinion is, and, for a long time, has been, in favor of the elimination of the limiting provision in it; but the obstacle to congressional action has chiefly been the strong prejudice against the corporate monopolies, the desire to curtail their privileges wherever practicable, and the consequent unwillingness to enact a new statute or amendment which should be retroactive, and hence amount to a virtual extension or rehabilitation of their patents, otherwise defunct. Now that the supreme court has spoken, congress may regard the subject in a different light, and relieve future patentees of the objectionable conditions which the statute imposes.

There is, of course, a natural and widespread demand for a list of the patents which have been terminated by this Bate decision, and for information as to just how and wherein important patents have been affected. But to prepare a complete register of all the American patents which have been destroyed or limited by the decision would be an absolutely impossible task, and for manifest reasons. There are no patents nowadays which are generally known by everyone as foundation patents; or, to put it another way, an industry may be founded on scores of patents, each for a detail. The owners of these naturally keep the fact of their limitation by prior foreign patents exceedingly quiet; and such circumstance never does come out in the natural course of things, except in the course of a litigation.

True, the fact whether or not any particular patent has been restricted by the statute is shown at once by the limitation which the patent office writes on the face of the grant, if the applicant formally acknowledges his prior foreign patent in his American application. Frequently, however, he does not make such acknowledgment, because the foreign patent may not have been actually granted at the time he files his American application. If, however, it becomes granted during the pendency of the latter, and the patent office discovers the circumstance, it usually compels acknowledgment. The discovery is often not made.

Or the American applicant, in his foreign patent, may have mixed

up the subject-matter of his American application with other inventions, or presented it in different guise, or as adapted to a different purpose ; and in this way, having convinced himself that his foreign patent is not for the same invention as that sought in the United States, he of course makes no acknowledgment of the former. The patent office rarely ventures to disentangle this snarl. To do so regularly would require a great addition to its present inadequate working-force and miserably insufficient facilities for research. It usually contents itself with unearthing earlier foreign patents which are unquestionably for the same invention, and sometimes wrangling over whether the foreign patentee—if of different name from the American applicant—was or was not in fact acting as the agent or with the constructive consent of the latter. At the present time it is somewhat uncertain over the question before noted as to the limitation of an American patentee's rights by an earlier foreign patent when granted to somebody else ; but, on the whole, it seems to incline to the negative conclusion.

Where no such limitation actually appears on the American patent, the existence of a prior foreign patent can sometimes be found by a search through the files of the foreign patents which are available at the Astor Library in New York, the Public Library in Boston, the Patent Library Office in Washington, and several other places. But, as all foreign patents are not published in printed volumes, such a search is far from conclusive of the non-existence of a limiting foreign grant ; and, in any event, it is a task involving special knowledge of the technicalities of patent law and always calling for skilled professional assistance.

# THE PROPOSAL TO LICENSE ARCHITECTS.

*By John Beverley Robinson.*

SOME forty years ago, while New York was still a small town; when the Forty-second street reservoir and the Crystal Palace, its neighbor, were far out in the fields; when Genin, the hatter, was the Dunlap of his day,—there was a fire in Broadway, near Prince street. As the firemen worked to overcome the flames, a catastrophe occurred; the beams of several stories, released by some unknown cause, fell together, killing several persons. Afterward it was found that the ends of the beams had rested on a four-inch brick wall, built up against an adjoining wall. There was general indignation at so inadequate a construction, and forthwith, as promptly as could be desired, "a law was passed" forbidding that particular fault in construction. Thenceforward, year by year, decade by decade, grew the volume of the laws regulating building,—from a paragraph to a pamphlet, from a pamphlet to a volume; still buildings continued to collapse with undiminished frequency and fatality. The business of seeing that the law was carried out was taken from the fire department, of which it had been a function, and was made an institution by itself, with a head, or at least a chief, a deputy-chief, and half a hundred understrappers.

Still buildings persisted in falling, until the latest crash—the Orchard street disaster—has caused a movement for the same old remedy,—further legislation.

As the dyspeptic earnestly desires more pie, in spite of his experience that it will not give the expected gratification; as the ancient farmer, having made himself an invalid with pill-dosing, thinks only of more, and more various, "physic" as an alleviant; as the Feejee islander renews his dances and sacrifices, after his hut has been blown away by the tornado, to prevent, if possible, the malign deity who has caused such destruction from repeating it,—so the mass of men, notwithstanding the continued demonstration of the inefficiency of law to produce the desired results, cheerfully, and with child-like faith, keep on, enacting new laws after each failure of previously-existing laws to do what it was hoped they would.

At this moment there is before the Albany politicians a measure which, by their sovereign power, they are urged to force upon the people, forbidding anybody to pursue the business of designing buildings without a license which a group of five men is to have virtually absolute power to grant or withhold. Such a measure, if passed,—and it

is altogether probable that it will pass, since in the wilderness the only voice that I hear in protest is my own,—will be thoroughly retrogressive, a step backward, undemocratic, un-American, tyrannical.

Set down, in the first place, the entire inefficiency that I have been talking about.

A building totters and goes down, and we enact a law; down goes another, and we enact more laws: a row of houses tumbles, and we get mad and enact four or five more laws and imprison a Buddensiek or two, and feel that we have guarded against such accidents in future. As we rest happy in our unjustifiable conclusion, a Park place horror comes, and, instead of looking for some more effectual preventive, we go back with undiminished fervor to our old resort of making more laws. On top of it all comes this Orchard street smash, where, though everything seems to have been done according to law, the building falls in utter ruin and several persons are killed.

Can nothing persuade us that the causes are deeper than law can remove?

Is it not possible to force upon our understandings that an engine that has so often failed to work as we wanted might as well be cast aside, and relief looked for elsewhere? Are we bent upon continually taking the turning that always brings us around to the point whence we started?

If it were that architects in general were known to be inefficient and incompetent, the measure might seem to be not so unreasonable. Is it true, though, that architects have shown themselves devoid of skill, intelligence, prudence? Have they not, on the contrary, at all times, and very conspicuously of late, shown themselves most able?

Have they not originated and developed an entirely new thing in construction, the steel frame building clothed with masonry and carried to an unheard-of height,—something which, if not involving any new principle, involves such radically new methods of using materials as to deserve as much honor; and have they not done this without a single overturn?

Are such men to be distrusted, hampered, regulated, tied up with red tape, forbidden to do their work without the permission of a select five who have demonstrated only their own skill in getting appointments for themselves?

On the other hand, are not buildings done by legal, governmental methods, with requisitions, and bids, and safeguards of all sorts, the most notable failures?

Were not the United States Building and the Illinois State Building at the Chicago World's Fair notoriously the worst designed there?

Is not the great public building in Chicago in a state of chronic collapse?

And where constructive stability is attained by governmental methods, is it not at an absurd and ruinous expenditure, as in the ugly and infamously extravagant Albany Capitol?

The profession at large has shown itself as worthy of the freedom it enjoys; as failing where hampered by restrictions.

The only deficiency has been perhaps among men hired at a cheap rate by speculative builders to "drore out" rows of tenements of conventional type, whom the speculative builder himself would never have trusted were he not confident that the building department, whose business it is to protect the dear public, would see that everything was right.

Strange to say, the bill now up expressly provides that this class of designers shall not be restricted. "Nothing herein contained," says Section 14, "shall be construed to prohibit any person . . . from acting . . . . as designer for any person employing him, with full knowledge on the part of such employer that the person so employed is not a licensed architect," thus assuring exemption from pains and penalties to the most unscrupulous cheap builder who chooses to hire the most incompetent cheap draughtsman.

I have always wondered that architects in general were so lost in admiration of a building law that tended to detract so much from the esteem their experience deserved by exposing them to the competition of the greenest hands, whose errors their clients thought were guarded against by the existence of the law. It might well have been entitled, "An act to help out the ignorant and enable them to practise architecture, and to diminish the emoluments of ability."

The inefficiency of the license system, or of any system of hampering free competition by legal restriction, is seen in other occupations where it prevails.

Take medicine, for instance: the time was when everybody thought that the doctor was a semi-supernatural being. Blue mass and black potion were swallowed with exemplary faith in their effects; without such prescriptions the patient would scorn the practitioner.

But now matters have changed; only the lower classes accept medical treatment blindly. The educated must understand the general meaning of the proposed treatment; will take nothing blindly; are strongly disposed to doubt the potency of medicine anyway, but at the worst do not doubt it as much as the faculty themselves. Both doctor and patient, however,—I speak still of educated patients,—look with equal distrust upon the raw graduate of the schools.

So, too, in law,—the closest guild that there is. What does a le-

gal diploma amount to? A good deal, no doubt, as assuring one a share in the proceeds that a monopoly may expect to acquire, but nothing at all to conciliate the confidence of an evasive client.

The often alleged and plausible reason for restrictive laws—the desire to protect the public; at first blush an eminently reasonable and laudable desire—on examination quite dissolves; the restriction proves to be rather a means for deluding the public into a false safety, filling them with the idea that a diploma-bearing individual is really competent. The only true protection that the public needs is intelligence in its choice of architects, or doctors, or lawyers, and full responsibility for a failure to use its brains successfully.

Liberty and responsibility develop intelligence; paternalism retards its growth.

Supposing, however, that the restrictions proposed could be shown to have power to produce the desired result, how is it possible for the most ideally perfect regulations to succeed, when committed into the hands into which they must be committed?

Into the hands, I mean, of politicians.

We have recently obtained some interesting information as to the inner workings of politics and of political appointees. True, we have before obtained glimpses of what went on. Long time ago our old friend Bill Tweed and his henchmen were shown up by a newspaper, probably because they refused to divide with it. Later came the celebrated Boodle Aldermen; and in other places there have been discovered boodle aldermen and boodle other men. Recently the most astonishing revelation of all has burst upon us. Rotten through and through, root and trunk, branch and leaf, we have found the political world, and we have set about "reforming" it in dead earnest, perhaps a little dashed by the promptness with which reformers become politicians and the extreme hesitation—to put it as suavely as possible—of politicians to become reformers.

Yet into such hands we propose now to commit the absolute power to suppress any member of an honorable and noble profession. Most astounding of all, the movement is fathered by that profession itself!

Oh, no! you reply, we have no intention of giving any power at all to politicians; our mind is to summon the ablest and wisest of the profession itself, and to let them have the job.

However able and wise architects there may be, it is not the ability to build well that will command the appointment on the State board; it is the ability to get appointed that will determine the matter. And the making a business of getting a place and keeping it is what constitutes a politician, whether the place be directly in service of a government or indirectly in service on a board of governmental appointment.

For, after all, this precious "State board" will depend for existence upon legislation, and upon its power to influence legislation, and, if that does not make it a political appointment and its members politicians, I do not know what could.

Conceive then the law passed, the board appointed, the whole scheme grinding away merrily. Add, if you please, that it works smoothly enough, that nothing but the recognized methods of influence are used,—acquaintance, friendship, do me a good turn and I'll do you one,—and that the secret, unadmitted methods as yet have not come into vogue. What is the result?

Inevitably the supplanting of the fervor and energy of free men by the cut-and-dried formulas of a close corporation. Gradually the influence of the board itself will make itself known in the appointment of successors. Slowly the particular style of architect admired by the members of the board will crystallize.

Eventually the life will be beaten out of it, and American architecture—the only living architecture—will lie a corpse, alongside the corpses of European architecture, in the Bluebeard chamber of governmental suppression.

I do not mean to deny that American architecture is crude, half-barbarous, unworthy of comparison with that of older countries: but I do say that its crudity is due to the fact that we, as a nation, are crude; that, in spite of its brutalities, it still has life and growth, and is not a mere appeal to precedents, as is the case in European countries,—a fact bewailed by European architects themselves.

Restriction means stagnation.

Let us leave the comparatively trivial objections that I have been urging, and dwell for a moment on more important questionings.

What is this right, so arrogantly claimed, of forbidding others to work at whatever they please; to call themselves by whatever descriptive title they may prefer? Are these people at Albany, in their lucid intervals, justified in voting anything they choose? Is the majority of the people, which they at Albany, are, by a legal fiction, supposed to represent, justified in enforcing any conceivable enactment upon the minority? If not, where is the limit?

Why should they not continue their wise measures, and require licenses for builders as well as for architects? Far more serious than—no, hardly that, but quite as serious as—the blunders of an architect might the blunders of a builder be.

Or let them restrict electric-light fitters, and electric-appliance makers, filled with possible danger from ignorance, both of them. Or let them go on and restrict grocers, and butchers, and bakers,—restrict everybody, require a permit for existence, Russian-fashion, in

the form of a passport! Ah, no, that would be tyrannical. Why that, and not this?

The truth is that, although a majority has the physical power to do anything it pleases, it is quite opposed to the theory of free popular government that a majority should exercise that power. "Oh! it is excellent to have a giant's might, but it is tyrannous to use it like a giant."

In a free government the majority is supposed to recognize the principle that it is not wise to use its power to the full; chiefly for the reason that, when it in turn becomes a minority, the machinery of tyranny that it has created will be used against it.

Therefore the majority from time to time, in Magna Chartas and Independence Declarations, promulgates the limits that are to be placed to the exercise of power, summed up in the statement that it is not wise to use power for anything but the defence of liberty.

Picture to yourself a man who has been practising as an architect for many years. He has won the confidence of many friends who testify of his skill to others.

He neglects to obtain, file, and pay for the registration of a license. He is arrested, hauled away, imprisoned, tried, and from fifty to five hundred dollars of his earnings taken by force from him. For what? What has he done? Whose liberty has he limited?

I am well aware that the present proposition is quite in line with what has been done in the past: the more reason now for speaking out.

It is true that the tyranny of the majority is daily intensifying; that the unjustifiable restrictions of medicine and law are added to by the recent restrictions of plumbers,—which, by the way, have stopped progress in plumbing in New York; that we fine poor men for trying to make a living by selling shoestrings; that there are a dozen other vocations similarly hampered, capped by the newest scheme for the licensing of chiropodists!

Yet we are such slaves in spirit, and tyrants as well,—for the submissive nature always complements that of domination,—that we do not even think, or know, or care, that our liberty is infringed.

For my own part, I repudiate it all. I do not regard any of the gentlemen at Albany as representing me. I do not acquiesce in anything and everything that they authorize. Their alleged right to govern lacks, in my case, the consent of the governed. Whatever they do, as far as I am concerned, they do by brute force, without moral right, including the tribute they exact from me.

If the majority does not recognize this reasonable limitation of its actions to the defence of liberty, a democracy becomes an intolerable

despotism,—worse than that of any monarch, for a despotic monarch may chance to possess liberal individual tastes, but a despotic majority is, like a corporation, without a conscience.

But I would not be understood as underestimating the astuteness of the gentlemen who have fathered and are fostering this particular measure to license architects. They know, the more perspicacious of them, well enough what they are about. The measure is really intended to restrict the number of accessions to the ranks of a profession which have of late been filling up rapidly. The competition of new men, especially of the incompetent, who are enabled to compete by grace of the building inspector's looking out for them, is becoming a serious matter. Other people get privileges from the representatives of the people; in fact, the chief occupation of the representatives is granting privileges. And the undeveloped crowd has so much admiration for a title and a diploma; almost as much as for that incontestable evidence of a pull,—a free pass. Therefore, as privilege breeds monopoly, and monopoly for some breeds scarcity for others, and scarcity of work reduces the amount to divide, why not add another privilege to the many that exist and check this fatal competition!

That is the true motive, and an eminently intelligible and rational motive it is; it has my unfeigned admiration.

Only I should be glad if the public, the dear public, were a little less fond of being protected by kind people who volunteer to protect it, and a little more fond of protecting itself. I think that all the members of the public, including myself, would be happier if they cared more for real protection against privilege than they now respect the false protection which involves tyrannical suppression of liberty, and is sure to eventuate in the creation of continually new privileges in unending complication.

I am well aware that protest at this moment is probably vain. We teach our children to perform adoring evolutions before flags which are held to symbolize freedom; we inculcate various phrases and songs implying a preference for freedom; but such external demonstrations tend to destroy and supplant the quiet inward knowledge of what liberty really is, which, when acquired, has no taste for announcing itself by such superficial and thoughtless enthusiasm.

The knowledge of true liberty, such as Thomas Jefferson and the rest of the coronal stars of liberty-lovers once promulgated, and for which the fathers fought, is rare; those who have it speak it not above their breath; every day our liberty is more and more encroached upon.

Yet no doubt the tide will some day turn, and new prophets will again proclaim liberty and all that it means to a people who will then maintain it better, because they will understand it better.

# HOW HOLLAND WAS MADE.

*By Foster Crowell.*

THE Dutch, we are told, gaze complacently at their marvellous country and say: "God made the sea, but we made the land;" and they are right, both in the fact and in their pride therein, for there is no other fatherland in the world that has been wrested from the sea, and no recorded work of man has been at once so bold, so vigorous, so intelligent, and so practical as the gigantic task which their far-away ancestors conceived, which their forefathers carried on with triumphant success, and which they themselves are to-day prosecuting on a more stupendous scale than ever. Away back, before the beginning of the Christian era, when the Roman conquerors came, or even before that, began the task that still enlists, after nineteen centuries of toil, the best efforts of an enlightened nation.

Where a brave and determined people struggle and stand in a common cause, as have all the Hollanders in this grand achievement, it is surely not right to attribute the success to any one class of workers; yet I think my professional brethren of the Netherlands may feel an extra pride in the results, for the reason that the efficacy of the work depended, and still depends, first of all upon the engineer, but for whom, probably, there would now be no Holland.

We shall see presently what part the engineer played, and how early in the dawn of civilization in Europe he appeared. But this, after all, is a side issue; we are now concerned chiefly with what was done, and, in order to understand it rightly as a process we must first turn our attention to a thing that probably does not exist outside of Holland, —a *Polder*. Polder is a Dutch word, which has no equivalent; at an earlier period it meant a lake, or pond, or bog, without natural drainage, the bottom being below sea-level; now it is used to designate a lake that has been drained dry, artificially, after being encircled by levees or dikes for protection against water from without and control of the water within. The word has attained in modern days a further and more exact significance, meaning an area of agricultural land of recognized boundaries, divided into separate (generally small) lots and ownerships, surrounded by dike protection, and requiring to be continually maintained in a state of efficient drainage by artificial means; it may or may not have been reclaimed directly from the sea. In other words, it has come to have a territorial significance. Those who have read Beekman's "Nederland als Polderland" need not be reminded of the vital necessity of the polders to the Holland of to-day.

"THE WATER MILL."

From Hobbema's Celebrated 17th Century Painting in the Amsterdam Museum.

IN AMSTERDAM. THE OLD "WAAG" OR WEIGHING HOUSE.

ZAANDAM POLDER.

RUYSDAEL'S "THE WINDMILL."

From the Painting in the Amsterdam Museum.

In his address of welcome* at the Inland Navigation Congress at the Hague last summer the president of the reception committee, Mr. J. F. W. Conrad, formerly inspector-general of the *Waterstaat* and a very high authority, gave a most interesting and instructive account of the polder region and its conservation, from which I have translated brief extracts for the present purpose: it was illustrated by a number of expressly-prepared maps and cuts, some of which are here reproduced.

(It may be of interest to state that these International Congresses are held in some one of the participating countries every two years; the fifth was held at Paris in 1892, the seventh is to be held at Rome in 1896. The sixth was participated in by 115 government delegates from 16 countries,—*viz.*, Netherlands, United States, Great Britain, Germany, Austria, Belgium, France, Hungary, Italy, Norway, Sweden, Portugal, Roumania, Russia, Siam, and Switzerland; also by 278 delegates of 27 Dutch societies and 162 foreign societies, and by 1048 subscribers, of whom 202 were from the United States.)

"In the course of excursions in the Netherlands," said Mr. Conrad,

*Compte-rendu des Travaux du Sixième Congrès International de Navigation Intérieure, La Haye, 1894, pp. 18–33.

"you will see the rivers, canals, and ports; the railways and the common roads; the dunes and the dikes along the sea-shore; and, in the vicinity of the polders, locks, windmills, chimneys of steam engines, embankments, and drainage systems. You will note that in those regions the occupied and cultivated ground is several meters below the level of the sea, or of the adjoining river or canal, the latter usually a navigable way, bearing thousands of sailing vessels and steamboats, engaged in commerce and industry. This complicated condition, which will very forcibly attract your attention, is the result of the circumstances to which the soil of Holland owes existence; a soil which, to be rendered habitable and tillable, must be artificially defended and protected against the threatening waves of the North Sea, the scour of the rivers, and the grinding of the ice, while at the same time it must be relieved of surface-water and infiltrations by discharge into the rivers, or into the ocean, which generally must be effected artificially, —at least, in the polder region. This situation has been produced in the course of centuries by the combined effects of nature and human industry."

With this picture, and the maps, before us, we will proceed to freely avail ourselves of Mr. Conrad's facts and figures without further quotation marks. About 59 per cent. of Holland is alluvial. The curved line extending from southwest to northeast on Map No. 1 in-

A NAVIGABLE WAY.

THE LEUVENHAVEN OF ROTTERDAM.

CANAL VIEW IN DORT.

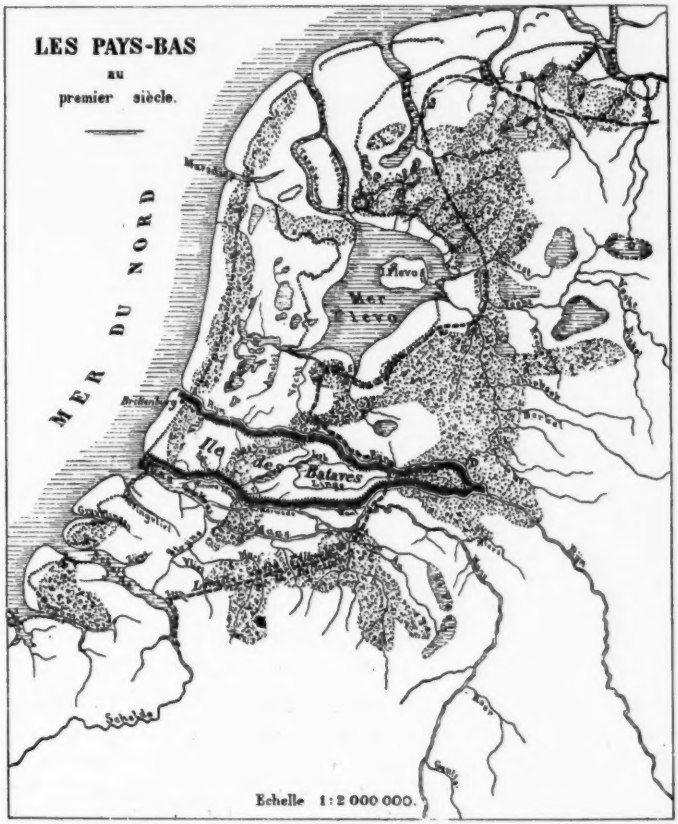
IN UTRECHT. THE OUDE GRACHT.

dicates approximately the western limit of the diluvial upland; the alluvial part contains 7500 sq. miles, which is about the size of New Jersey. Geology tells us that at the end of the diluvial period all the western part of the low countries was a shallow, interior, sand-bottomed lake, separated from the North Sea by a chain of sand dunes, into which flowed the rivers Rhine, Meuse, Vecht, and Yssel; in course of time, the bottom of the lake became covered with deposits of marl and clay, and these in turn with peat-beds 10 to 15 ft. thick, formed from water-plants and the *débris* washed down from the upland forests. The peat-beds extended over the entire area at present occupied by North and South Holland, and parts of Frisia, Groningue, and Over Yssel. Great forests grew upon them, and at length became peopled with Germanic tribes,—the Batavians of the Roman chronicles.

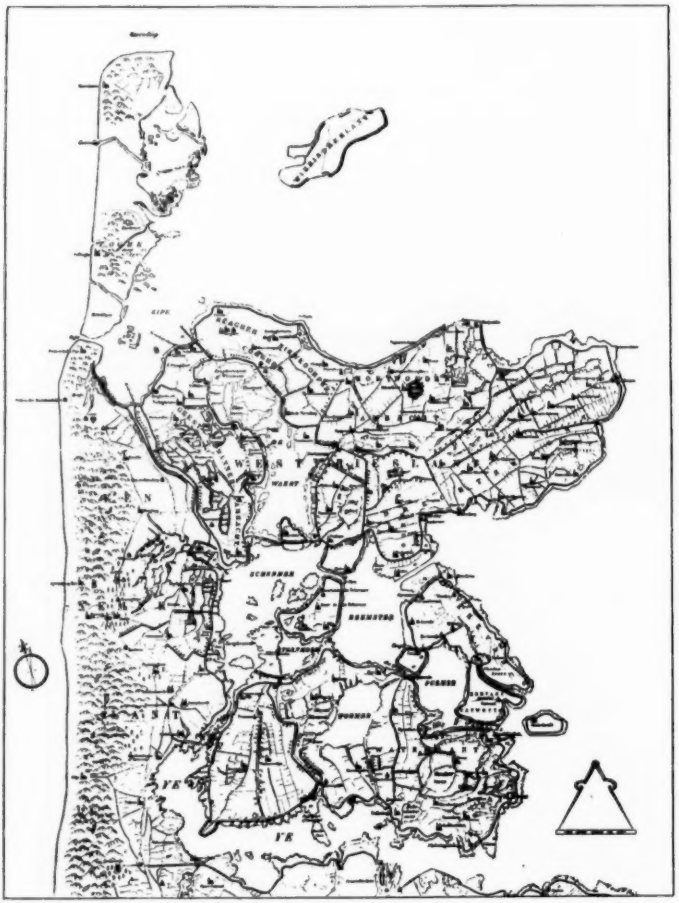
The Roman general, Claudius Drusus, who waged war upon the Batavians, built a dike along the left bank of the central arm of the Rhine, and his successor, Paulinus Pompey, continued it to the North Sea near Katwijk: this dike—the first to be built in the Netherlands—is shown by the fringed line on Map No. 1, which has been compiled by the eminent geographer, Kuyper, to give a general idea of the low countries in the first century, when what is now the northern

part of the Zuyder Zee was a peat-bog covered with slimly-inhabited forests, while the southern was a large fresh-water lake, called by the Romans Lake Flevo and in the middle ages Lake Almeri. The peat was excellent fuel, and the excavations made to obtain it by the early inhabitants formed the first step in the transformation of these lowlands into numerous ponds, large and small, united by the water courses of the swamps.

Claudius Drusus not only built the first dike, but cut the first canal, through which his son Germanicus, according to Tacitus, conveyed his army on rafts of timber felled on the island of Batavia; it




MAP NO. I.—THE LOW COUNTRIES IN THE IST CENTURY.



MAP NO. 2.—NORTH HOLLAND IN 1288.

united the Rhine with the Yssel, and was known as the *Drusus gracht;* it is indicated on our map by the letter D.

Inundations during the seventh, eighth, and ninth centuries, and especially those of 1170, 1230, and 1237, continually and greatly enlarged the communication between lake and ocean, and so the destructive effect of the incoming tides became greater and greater; the

soft peat formation was undermined, and the surface sank or was swept away. By the year 1395, 1500 sq. miles had thus been swallowed by the sea, which means that all the firm ground, excepting the fringe of islands of North Holland and Frisia as at present, had disappeared from the northern part of the Zuyder Zee, which had become one with Lake Flevo. That was the culmination of the destruction.

To fully narrate how this vast watery waste was transformed into a fertile country studded with fair cities would fill many books: in this brief paper we can only touch upon the most striking features, confining ourselves to one typical part of the country, the province of North Holland, in which the peat workings had become, by 1221, very valuable and extensive, while the wave-action and the freshets were ceaselessly widening the channels and extending the ponds.

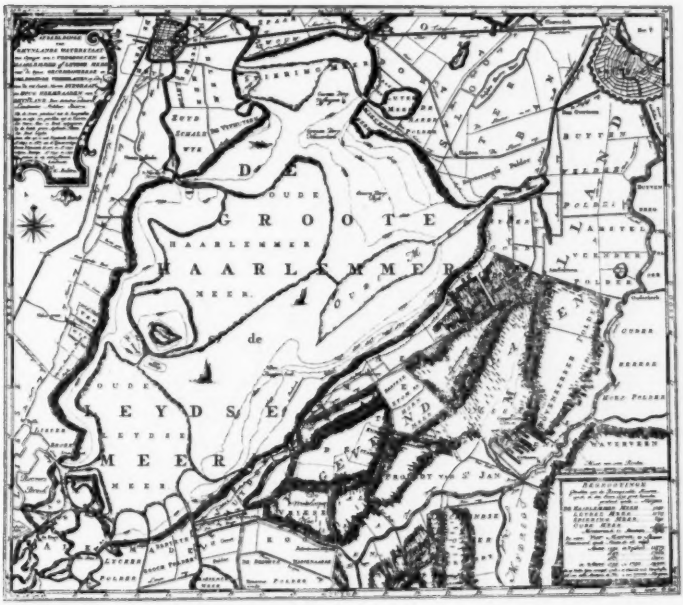
North Holland of 1288 is shown on Map No. 2, which has been reconstructed by State Counsellor Doctor G. de Vries. The earliest geometrically-projected Dutch maps which possess any considerable degree of exactitude are those of Jacob Roelofszoon van Deventer, showing Holland south of the Y in 1542, and of Jacob Janzoon Beeldsnyder, who, by order of the Duke of Alba, plotted in 1573–75 a chart of North and South Holland between the sea-dike of West Frisia and the branch of the Rhine known as the Leyde. This last was printed in 1610, and is reproduced here, very considerably reduced, as Map No. 3; with other data from ancient records, it served as a basis of the 1288 map.

Northern Holland in 1288, as we see then, was composed mostly of sheets of water, formed partly by natural causes and partly by the peat workings, and which, as far as the lakes of Schermer, Beemster, Purmer, Stammer, the lakes west of Alkmaar, and Langemeer (see Map No. 2), communicated with one another and the Zuyder Zee, so that it was possible at that time to go by boat from Amsterdam westward to the Gulf of Y, thence through the North Holland lakes, and return to the starting-point by way of the Zuyder Zee, without encountering a single impediment in the shape of dike or lock. A great part of North Holland was thus directly exposed to the inroads of the sea, and there were besides, outside the limits named, other large peat lakes, of which the Waert and those lying north of Wormer were the most important.

After the destruction of the country in the northern part of the Zuyder Zee, the sea-tides came to have much greater effect, and the dikes and *kaden* which had been built by the people around their dwellings either succumbed or were in constant peril. To remedy this dangerous situation three openings were closed by dikes: first that of Etershem, by establishing the Schar-dam some time between 1311 and

MAP NO. 3.—HOLLAND IN 1575.

Reproduced from Beeldsnyder's Original Chart drawn for the Duke of Alba.




MAP NO. 4.—SHOWING SUCCESSIVE STAGES OF HAARLEM LAKE, IN 1531, 1591, 1610, 1647, 1687, 1740, AND 1848.

1319; next the Crommenye, by the Niewen-dam in 1357; and then Purmer Ee, by the Monnicken-dam in 1400. The river de Zaan had been diked previously to 1288,—probably because of the historic high-tide of 1237. We thus have North Holland as represented on Beeldsnyder's chart; it will be noticed that the changes between 1288 and 1575 were relatively insignificant. One is tempted to follow this interesting lead, but can pause only long enough to see what the famous Haarlem Lake of our times consisted of in 1575; for which purpose we will cast another glance at Map No. 3, and also at a special reproduction—Map No. 4—of the comparative conditions at intervals from 1531 to 1848, the date of its final drainage. This shows that during the 300 years covered by the map the superficial area of the four lakes of Spiering, Haarlem, Leide, and Old lake (which first were either separated by dikes, or connected only by very small streams, and became merged in one called the Haarlem-mer meer in 1591) increased from 5600 to 16,850 hectares (65 sq. miles), or almost exactly three times.

There is no indication that until near the ending of the sixteenth

century the good burghers of Holland felt the need of any more fields and pastures than their slender share of dry land afforded; if they did, it is probable that money was lacking and the technical means were not understood sufficiently well to warrant an attempt to dike and drain the lakes whose soil was so excellent.

Nevertheless, the three essential contrivances were already known and applied,—namely, canal locks, mills for raising water, and, of course, dikes. Locks consisting of two gates and an intermediate chamber, such as are in use to-day and which are generally termed lift-locks, have commonly been ascribed to Leonardo da Vinci. It is very interesting to hear from such a high authority as Mr. Conrad on this point, and, in order that there may be no misunderstanding, I quote him as closely as translation permits.

"There can be no doubt whatever that lift-locks are of Dutch origin, and were first established in Holland. It has been claimed by some that the pass at the Sparen-dam cited in the charters of Count William II, King of Rome, dated April 9, 1253, and October 5, 1255, and indicated in the original Latin text by 'Spoya,' was a lock, either with sliding gates or with a chamber, of simple construction, but capable of taking vessels with cargoes from the Y to the Spaarne, and also in the opposite direction, through the dike established about 1250 at Spaarndam. Although this allegation does not rest upon a very exact basis, it is nevertheless true that Count William III, in a charter dated 1315, confirms the lock rights (*droits d'écluse*) at Spaarndam, while a letter written concerning Holland in 1413 by the Count of Hainant makes mention of locks (*écluses à vanne ou à sas*) near Amsterdam. The locks at Vreeswyk in the famous Lek dike were constructed in 1435. From the above facts I claim to have proved my point and that I may be allowed to observe that the following statement of M. DeBauve, Ingénieur des Ponts et Chaussées, on page 220 of his Manuel, Paris, 1878, is not exact,—to wit, 'the invention of lift locks (*écluses à sas*) is generally attributed to Leonardo da Vinci and not earlier than 1460, but M. Lombardini has proved that the first lock of that kind was built by Philippe Visconti in 1439 to facilitate the transportation of marble for the Milan Cathedral; it was near Milan, and overcame a fall of 3 meters (9 or 10 ft.) between Laghetto Vecchia and Laghetto Nuove.'"

Wind-mills applied to the displacement of water have existed in the Netherlands for centuries, and are a Dutch invention. In a note by a certain Philip Van Dorp in 1408 mention is first made of "water mills." It is very probable that they were used in draining Lake Limmer and Lake Nesch in 1430, and it is certain that they were used at Schoonhoven in 1452. After the latter date they are frequently

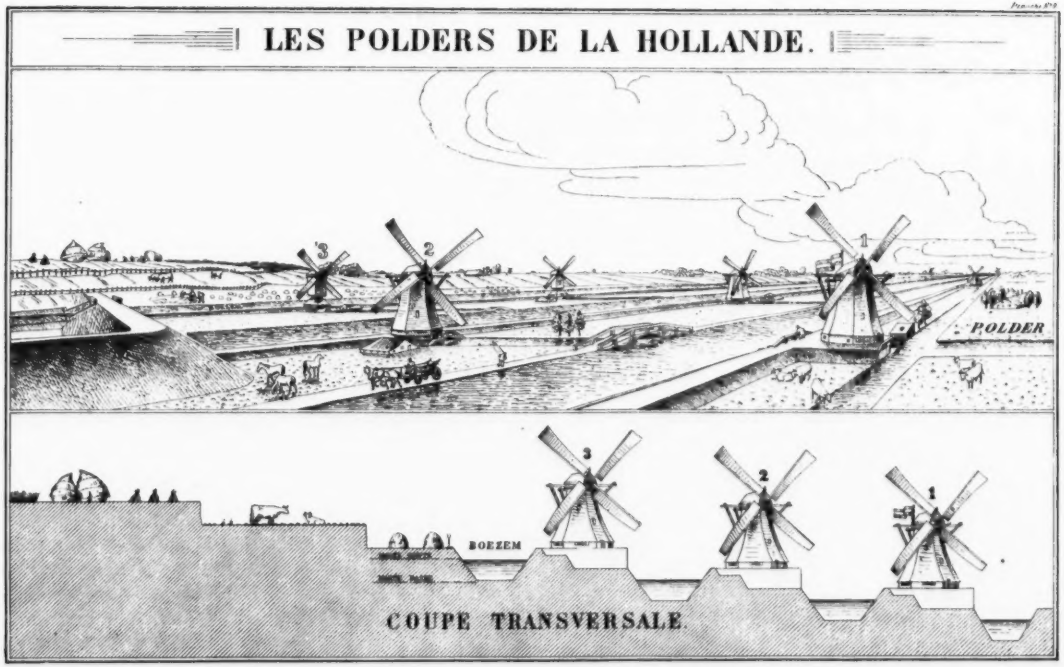
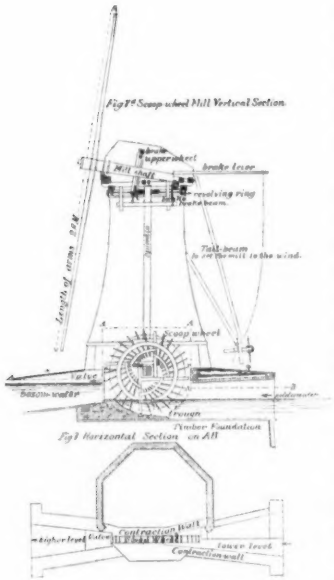



PLATE 5.—A TYPICAL POLDER OF THE 17TH CENTURY.




A SCOOP MILL.

From Beekman's Nederland als Polderland.

mentioned; their construction and management, at first very crude and primitive, were very soon greatly improved, and the evolution has continued to the present day.

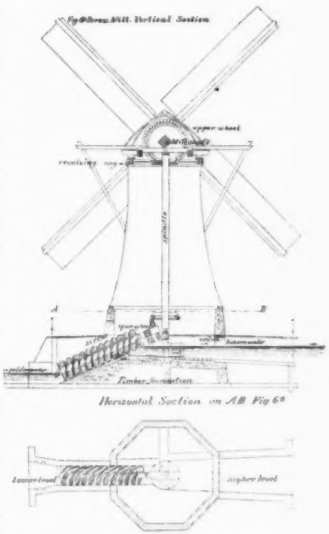
Already, then, in the fifteenth and sixteenth centuries a few small lakes had been drained by windmills, and even Zype, with an area of about 26 sq. miles, had been so treated in 1597; but the great drainage period began with the seventeenth century, resulting from the return of prosperity and the revival of the spirit of enterprise, coupled with the fact that considerable capital was available for agriculture, cattle-raising, and manufactures. In the 28 years ending with 1635 thirteen large lakes, aggregating 92 sq. miles, were diked and drained by windmills, not counting many small ones. "The Dutch had taken Holland." Although, since the advent of steam, it has become possible to carry out similar operations on a much more extended scale, the work of the seventeenth century was typical and complete; in fact, taking into consideration all the attending circumstances, it was even grander in conception and execution than the majestic modern achievements.

We must pass over the difficulties and disasters which the courageous engineers overcame: that they were many and great, and often unprecedented, there is no doubt. Each lake had first to be girdled with a water-tight ring-dike; practicable and efficient water-mills had to be properly located and built; and artificial channels for evacuating the water had to be prepared in advance. The level, as we should say, into which the water was evacuated was called a *boesem*, and the various channels constituted a net-work of canals which served for navigation, and which was in turn separated from the sea or from a river by a strong dike protecting all the drained country. These outer dikes were provided with locks for navigation and also for discharging the superfluous water of the *boesem*. The great Schellingwoude dike has

five locks, some large enough for ocean steamers. Often provision had also to be made for supplying water to the polder in dry seasons.

In polders close to the sea—as, for instance, on the island of Walcheren—the inner waters were discharged into them without the intervention of either a *boesem* or an outer dike; but in such cases there were usually interior walls or *kaden* subdividing the polder for greater security, just as a ship's hold is divided into compartments.

In course of time most of the natural water-courses, including some of the greater rivers, were dammed, sometimes at several different points and elevations, so as to be incorporated into the canal system, and so gradually was produced the Holland of to-day.



A SCREW MILL.
From Beekman's Nederland als Polderland.

It is to be noted that there are four distinct classes of dikes with separate functions; (*a*) the inner or ring-dikes, as impervious as possible, but not usually requiring great strength; (*b*) the river dikes, or quays, requiring strong protection against ice and floods; (*c*) river dams proper,—important protected structures with navigation locks and sluices; (*d*) the sea dikes, exposed to violent storms and wave action, with locks for navigation and discharge. Frequently also the sand dunes required to be artificially augmented, or treated as dikes. The varieties of structural features and conditions are so multifarious that an attempt to describe them here would prove most unsatisfactory. The reader may find a complete account of all the typical structures in Starling's admirable work on the subject.*

OUTWATERING SLUICE AT KATWIJK.

Besides their primary functions, the dikes have a further most useful one, for in nearly all instances they sustain paved or graveled

* "Some Notes on the Holland Dikes." By William Starling, M. Am Soc. C. E. *Transactions* American Society of Civil Engineers. Vol. XXVI. June, 1892. Norman Medal Paper. The cuts on pp. 220, 221, and 222 are used with the kind concurrence of the author and the permission of the society.

roads of most excellent character: in some cases they form railroad embankments.

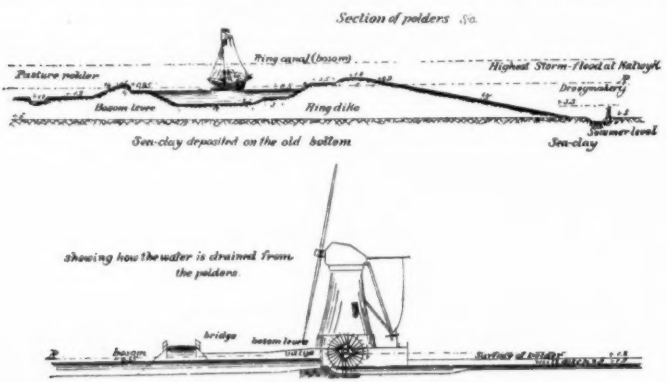
Plate 5 gives a typical polder, with all its characteristics, the mills being arranged "een gang," or series, on account of limitations of lift; it really shows one of the very early examples, for, when Beemster Lake was drained in 1612, forty-four mills were erected, arranged in eleven gangs of four each, which were necessary to drain 28 sq. miles.

While steam power is coming more and more into use in Holland for drainage purposes,—chiefly because there are too many calm days,—it is interesting to note Mr. Starling's statement that there were still in service in 1892, in the Rhineland district, two hundred and sixty wind-mills for drainage, exclusive of Haarlem Lake, which is served wholly by steam, the Cornish engines which were built to pump it out in 1848 being still employed.

This Harlaam-mer-Meer operation still "holds the record"; its polder covers 70 sq. miles; its ring dike is 17 miles in circumference; more than three years' pumping with 1200 h. p. was required to drain it, and the entire work consumed 12 years,—from 1840 to 1852.

The next in importance, of late years, are the results of the construction of the Amsterdam North-Sea Canal, 1872 to 1878, consisting of eleven polders aggregating 23 sq. miles.

But all are dwarfed into insignificance by the works in contemplation in the Zuyder Zee, which will comprise 18 miles of sea dike; reclaim 211,830 hectares, of which 187,000 (equivalent to 720 sq. miles) will be fertile arable land; require 17,000 h. p. for pumpage;




A TYPICAL OPERATION.

consume 33 years in building; and cost, including interest, 315,000,000 florins, equivalent to $126,000,000.

Next to the sea-dikes the most vital features of all are the sea and river outlets. Where these also serve for navigation, locks, of massive and very perfect construction, are employed. Otherwise what is known as an "outwatering sluice" is used, consisting, in general, of a masonry culvert with gates. The larger examples are very elaborate structures, and even the smallest must be built and maintained with greatest care and skill, placed, as they are, in earthen dams and working under considerable head.

The largest and most celebrated, built in 1807, is at Katwijk on the North Sea. Mr. Starling mentions it as the finest work of its kind in Europe. It is a "flushing sluice," the inner water being accumulated to obtain sufficient head to sweep away aggregations of silt, or of sand thrown up by the sea. If the inner water is insufficient, sea-water is admitted, at the flood, into an intermediate chamber, 1500 meters long, between the innermost and outermost gates. (See cut page 221.)

I again refer the reader to Mr. Starling's work for the details of the locks and outlets; also to Wheeler's "Drainage of Fens and Lowlands" for descriptions of the mechanical features of the large drainage plants, notably that at Katwijk, the largest in Holland at present.

We have, however, larger pumping plants in the United States, and it is interesting to note in passing a statement by Professor Telders of Delft, in a monograph on the subject, that the newest Dutch plants contain American pumps.

The proper maintenance and administration of the polder system are as important as its enduring construction. The State—that is, the Crown—provides for and assumes the construction and control of all the great works, but it administers and maintains only such features of them as are essentially for general public use. By the constitution of 1848 the Crown has the supervision of everything that concerns the *Waterstaat*, including roads and bridges; but the entire system of polders is cared for by colleges of administration, or, as we would style them, local boards, elected by the proprietors, who pay the necessary expenses (which average about $1.00 an acre annually, roughly speaking) in proportion to ownership, the polder land being divided into small holdings and sold. Sometimes there is a separate organization for each polder, but, where several use a common *boesem*, or where some other economical reason exists, their control is united in one body known as a *Waterschap*. In either case the principle is the same,—*viz.*, what is necessary for the conservation of the kingdom is paid out of the public purse; whatever special benefit accrues to the users they pay for directly, and it is thus made their vital inter-

est to keep up the entire safety and thorough efficiency of the system. In the Zuyder Zee reclamation the direct cost to the Crown will be in round numbers at the rate of $275 per American acre of arable land, less whatever is obtained from subsequent sales to individuals. The value to the nation is not, of course, measured by this price, for, besides providing an additional bulwark against the sea, the reclamation means new farms and homes for at least half a million people.

More than half the 1500 miles of Holland's coast line and 500 miles of her rivers are diked: the inner dikes can scarcely be estimated. Yet all that vast and costly work is but a part of what these intelligent and indomitable people have done for themselves. I need only enumerate four great works, recently finished or still in progress,—*viz.*, the Amsterdam Ship Canal, costing $14,000,000; the new Rotterdam water-way, $13,000,000: the Merwede Canal, $10,000,000; the New Maas Mouth, $6,000,000: in all, $43,000,000 spent for better navigation by a population of but 4,500,000.

The "great drainage period" for the United States will come in the twentieth century. Millions of acres in the Mississippi valley, along the Missouri, on the Wabash bottoms, in the water-logged eastern Carolinas and Florida, and elsewhere, seem already to invite a new type of agricultural capitalist, but the time is not yet ripe for execution. Meanwhile we have ready to our hands this wealth of Dutch experience. Our problems will be simpler, perhaps, in some respects, and differ largely in others, but in the main they have all been encountered and admirably solved by the engineers and the statesmen of Holland.

# EDUCATIONAL INFLUENCE OF MACHINERY.

*By Alexander E. Outerbridge, Jr.*

AN impression prevails in the minds of many intelligent people, more especially, perhaps, among those who are not directly engaged in mechanical pursuits, that the tendency of modern methods of manufacture in the substitution of machinery for hand-labor is detrimental to the intellectual development of the wage-earner in that it makes him an automaton, like the machine which he tends; that the workman in a great factory loses his individuality; that the handicraftsman of a former generation has disappeared, and that his successor is a mere marionette, to whom the gift of brains is a superfluity.

It is the object of this paper to present briefly a different and, in some respects, a novel view of the educational influence that machinery exerts upon the mental and moral development of the workingman, and to show that the introduction of new inventions, so far from being an oppression to the wage-earner, is, in fact, his greatest boon. These conclusions, which are the result of daily observation for a number of years in large industrial works, are at variance with the opinions of those theorists and economic writers who maintain that mechanical occupation is necessarily narrowing to the intellect.

While freely admitting that the high school and the university are magnificent—indeed ideal—educational forces (of which, however, only the privileged few can avail themselves), I shall hope to prove that the lathe, the loom, the locomotive, and hundreds of other machines, great and small, are doing their share, day after day, to elevate the less favored masses to a higher social and intellectual plane.

Through the educational influence of machinery the operative of to-day is not only the peer, but the superior, of his predecessor in all the qualifications that form the mental gage by which we may measure the intellectual and social relation that an individual bears to the community in which he lives. The mechanic of to-day, who is engaged, for instance, in riveting a boiler, or a bridge structure, no longer spends ten hours a day in striking blows with monotonous regularity with a hand-hammer upon the rivet heads, but he is employed to control the steam or hydraulic riveting machine,—a sort of giant hand, which presses the red-hot rivet into place, with a single silent squeeze of its powerful finger, far more effectually than can be done by two strong men striking one hundred blows each with a riveter's hammer. Indeed, at an official test, made some years ago, it was found that to drive an ordinary 5/8 in. rivet by muscular power required about two hundred and fifty blows of the hammer; and then

the work was imperfectly done, for the reason that sufficient pressure cannot be given by such midget taps to the metal while still plastic to cause it to flow into all the irregularities of the rivet-holes.

It is not surprising that a stitching machine with such capabilities should have superseded hand-riveting of metal sheets as completely as the sewing machine has usurped the place of the seamstress's needle in stitching cotton sheets.

Innumerable illustrations of the amelioration of exhausting labor by substitution of powerful machines for puny arms could be given. Look at a great steam hammer giving, at one moment, herculean blows in rapid succession, and at another such gentle strokes as to crack the shell of an egg without smashing it! This is truly "the iron hand in the velvet glove," and the leviathian is perfectly controlled by a boy at the throttle.

With respect to the educating and elevating influence of machinery upon the mind of the workingman, I wish to present three distinct, yet closely related, propositions.

First: the educational power of the machine itself.

Second: the intellectual force of the inventor incorporated in the machine and influencing the mind of the operator.

Third: the educational and refining influence of the products of machinery through the cheapening of the cost and concurrent widening of distribution.

### I.—THE EDUCATIONAL POWER OF THE MACHINE ITSELF.

I am satisfied that an insensate machine, in the material combinations of which, however, the skilled designer "has embodied his own mental faculties, so that it is constrained to do his will when power is applied," performing accurately the most complex operations, exerts a stimulating educational influence upon the care tender, even though he may be an illiterate man or boy entirely unconscious of this influence. If you give a boy of average capacity the simplest routine work to do in connection with a machine,—it may be merely to feed it with raw material,—he will, at first perhaps, perform his task in a perfunctory manner, taking little interest in the work and having no comprehension of the mechanism of the machine. Little by little, however, the constant repetition of mechanical movements, producing always one uniform result, impresses itself upon his latent powers of observation and comprehension, the underlying principles and heretofore hidden motive of the seemingly inexplicable combination of wheels and gears is revealed, and simple order is evolved out of complexity; a new interest is developed and the boy becomes an intelligent operator.

On revisiting the establishment after a lapse of time you may find the same machine, and the same, yet not the same, attendant; he has become, it may be, an expert; he is now, perhaps, the master of the machine, knowing its imperfections and sometimes even suggesting improvements which had been previously overlooked.*

Remarkable testimony to the educational power of machinery was furnished by the wording of a certificate accompanying an award of the "Grand Diploma of Honor" by the International Jury of Awards of the World's Fair in Vienna, in 1873, to an American exhibit of machine tools,—*viz.*, "designed to bear the character of peculiar distinction for eminent merits in the domain of science, in its application to the education of the people and the advancement of the moral and material welfare of mankind."

The educational influence of mechanical ocupation upon the workingman is strikingly illustrated in another manner. You will find in all large industrial establishments employees who exhibit as much skill in their special work as that of well-known original scientific investigators; they are daily performing operations as delicate in their way as the work of the microscopist, and with a degree of accuracy amazing to the novice. Take, for example, the simplest operation of calipering a tube, or measuring a rod, and you will find mechanics dealing quantitatively with minute fractions of an inch which ordinary people totally disregard.

In many modern machine-shops you will find mechanics to-day measuring electrical forces, using instruments and formulæ which but a few years ago were the subject of profound mathematical discussion and experimental research by Lord Kelvin and other world-renowned investigators, and which resulted in an international congress to establish the units of electrical measurement.

The educational influence upon the operative of daily contact with machinery is thus, in my judgment, a potent one, enlarging his mental horizon, giving him more accurate perceptions of the true relation of parts and fitness of things, and elevating him intellectually above the average plane of the skilful handicraftsman.

*In the course of an address upon "The Relation of Invention to Labor," delivered by the Hon. Carroll D. Wright, commissioner of labor, on the occasion of the celebration of the beginning of the second century of the American patent system at Washington in 1891, Mr. Wright said: "If the lowest grade of employment leads to self-respect, and the dignity and repose even which come of self-support (a proposition which cannot be denied), how ennobling must be that employment which not only stimulates the highest faculties, but also excites admiration for the perfect and love for the beautiful! A man cannot superintend the movements of a complicated piece of machinery and not feel this working influence, and, maybe, become the better for his experience. His mind intuitively takes on the harmony of action, and finds itself running in tune to something which represents embodied thought. Any man witnessing the operations of the wonderful mechanism of the needle machine feels a continued influence from his observations. There is something peculiarly educational in the very presence of the working of mechanical powers."

The most perfect machine ever constructed only approaches, never realizes, the ideal of its designer or constructor, and it is, therefore, impossible to entirely eliminate the "personal equation" of the operator. Look, for example, at a modern iron planing machine (which is an embodiment of all the tool virtues that can be enumerated) taking a final scraping cut from the surface of a piece of metal; though this surface may seem to your sight and touch as smooth as a mirror, the inspector will casually rub his finger over it and detect ridges not exceeding, perhaps, a few thousandths of an inch, the work resembling to him a ploughed field, in which, if the furroughs exceed a most minute allowance, the work must be repeated again and again, until the the microscopic imperfections of the man and of the machine have been eliminated from the work; indeed, wherever absolute truth is required in bearing surfaces of metal, hand-scraping is still the final resort.

It is, therefore, not merely the ability to turn out a maximum amount of work from any machine tool which constitutes the skilled mechanic. No matter how nearly automatic the machine may be, it is still subject to human guidance; and, no matter how nearly perfect its construction, its work is still subject to final correction by that most wonderful of all machines, the human hand guided by the human mind.

The limitations of this paper will not permit us to pursue further this interesting psychological phase of the subject; let us pass, then, to the consideration of the second proposition.

### II.—THE INTELLECTUAL FORCE OF THE INVENTOR.

*I believe that every novel machine possesses something of the personality of its creator.* I believe, furthermore, that it is possible to trace though the machine, back to the inventor, a positive and continuing influence of his mind upon the mind of the operator.

I believe that the special mental development of the present generation of American engineers and mechanics may also be traced through historical relics to the subtle quality of mind with which famous American inventors have endowed their creations; these forces have been silently working to mould the minds of men in characteristic grooves, so that it is as impossible to mistake a purely American machine for a foreign production as it is to mistake a Chinaman for an Indian. This characterization may be even more sharply defined; it is not an unusual observation among mechanical experts to-day that machines produced by one establishment may often be distinguished from similar machines of another make (without the aid of any name plate) through a peculiar "something" which the Frenchman expresses with a shrug and "*Je ne sais quoi.*"

To further elucidate the novel idea, contained in my second proposition, I will ask you to suppose that a number of inventors, who are living in different parts of the world, surrounded by different environments, and having different experiences, conveniences, and necessities, are all engaged independently, at the same time, in solving some new problem in mechanics, or in designing some novel machine to perform special work (we have had many such illustrations in recent years in the numbers of new inventions in connection with the employment of electricity for utilitarian purposes). You will find that different minds evolve different methods of accomplishing one ultimate result.

One inventor will proceed by the most direct method to attain the final end; another will take a more devious course, and produce, it may be, a more complicated machine; yet it may also be difficult to decide upon their relative merits, since one may gain in refinement and accuracy what it loses in other features. Each machine exhibits in its design the mental process of the inventor, and each has, therefore, a distinct individuality incorporated in it, emanating from its creator, and this in turn exerts a continuing influence upon the mind of the operator.

Numerous citations could be drawn from historical inventions to illustrate the views here advanced, but our own period and country afford the most interesting examples of personal characteristics impressed upon inert matter and incorporated in the machine. Those who are familiar with the startling discoveries and inventions of the brilliant and original mind of Tesla may not, perhaps, find it difficult to trace a resemblance between the man and his creations which is more than mere idle fancy.

The inventor of that marvellous machine, the phonograph, which will forever proclaim the name of its creator in sounding words of praise, has woven his mental characteristics into its simple combinations of inert matter so that they are differentiated from all other aggregations of such materials, and, although the practical uses of the instrument have not been fully developed, I believe that further study of the apparatus is destined to exert a decided influence upon the trend of thought and invention in other directions as yet unexplored, and that it is an "epoch-making invention," which is therefore peculiarly suitable as an illustration of my theories.

### III.—PRODUCTS OF MACHINERY VS. HANDICRAFT.

The cheapening of manufactured articles through the aid of machinery is always followed by an equivalent increased demand, the former luxuries of the rich thus becoming ordinary conveniences in the economies of life; moreover, new occupations are provided for thou-

sands, nay, hundreds of thousands, of working men and women in the manufacture of all that appertains to such machines.

It is true that temporary disarrangement of various trades has occurred through the invention and rapid introduction of machinery with which hand-work could not compete; but re-adjustment to the changed conditions has quickly followed with ultimate beneficial results to the wage-earner.

Whatever view we may entertain upon this subject, it is a pleasure to note that, at the present time, we seem to have entered upon a formative period in the history of the world's industrial work.

The destructive period, or the breaking down of handicraft by machinery designated by Mr. Wright as the "contraction of labor," has been practically accomplished, and the recent grand inventions do not entail the displacement of hand-labor in any form, but, on the contrary, have been direct creators of new industries representing already the investment of many millions of dollars and giving employment of lucrative and elevating character to vast armies of wage-earners in entirely new fields.

Within the past decade new industries connected with the application of electricity to utilitarian purposes have sprung into existence as if by magic, and have at once taken front rank, outstripping in importance, in wealth, and in the numbers of active workers employed therein, many trades and professions inherited from former days. These are the giants of this formative period.

Few persons, even among those who are foremost leaders in these new occupations, realize what gigantic forces have thus been developed in the industrial world within this very brief period. It is impossible to forecast what the future may bring forth; even though no further discoveries should be made in fundamental principles, sufficient new "raw material" is already provided, waiting to be woven into our industries, to assure a condition of activity for years to come.

Contrast the life and environment of the operative to-day (ignoring the temporary disarrangement of industrial laws and operations through ill-devised financial and tariff experiments) with the worker of a past generation. No longer will you find men, women, and children crowded together in dimly-lighted, ill-ventilated, small rooms, often used as working and living apartments [of course, I exclude the criminal "sweat-shop" system of the tailor's trade], but in all the large industrial establishments you will notice that air, light, heat, and sanitary arrangements, as well as provision for the comfort and convenience of the employee, have been carefully considered. The operative is no longer regarded as a mere machine, but as an intelligent being, whose business it is to control machines.

Whence comes this superior intelligence of the modern wage-worker? Is it not largely due to the influence of machinery, embodying in itself the material essence of the mind of the inventor, with which transmuted influence he is brought into daily contact? Does he not earn, and receive, larger wages by reason of this acquired superior ability, and is he not enabled, through the cheapening of all machine products, to purchase comforts, conveniences, and luxuries that were entirely unknown to his ancestors? Have we not shown that the machine is as tireless a teacher as it is a worker, and that, instead of proving the workingman's enemy, it is his truest friend?

Should the reader desire optical demonstration of all that has been here claimed, he should visit "modern Philadelphia," known as the city of homes for workingmen; taking the workingman's swift modern conveyance, he may speed through miles and miles of smooth streets, paved with asphalt, and view thousands of neat, even elegant, little homes, occupied and owned, in large part, by workingmen; he may enter these homes, as I have done, and find many appointments which he has been accustomed to regard as luxuries of the wealthy contributing to the comfort, convenience, and mental and moral elevation of wage-earners composing such families.

I am not drawing an imaginary, or even an exceptional, picture, but only stating facts which can easily be verified, and which are sufficient in themselves to prove that the introduction of new machinery, so far from being an oppression to the workingman, is his greatest boon; and I think the reader will then agree with me that, while the university and the high school are grand educational forces, the loom, the lathe, the locomotive, and hundreds of other machines, great and small, are doing their share, day after day, to elevate the less favored masses to a higher social plane through the educational influence of the subtle mental force with which the inventor has unconsciously endowed the combination of inert materials forming his machine.

That mind and matter can be so united as to constitute a distinct force or quality will seem, at first glance, merely a quaint fancy, but I am more and more convinced, through daily observation, of its actual entity; and it is, after all, not more strange or mysterious than is the fact that we may to-day listen to the fleeting voices of sweet singers and of great thinkers who have "passed beyond," through the aid of that simple combination of dead matter the phonograph. *

* In advancing these views, I wish to disclaim all association or sympathy with those vague impressions of day-dreamers which are variously designated under the names of "Spiritualism," "Animal Magnetism," "Psychic" or "Odic force," etc. Nevertheless I repeat that I believe that every novel machine possesses something of the personality of its creator, and, further, that this quality exerts a continuing influence upon the operator.

# THE GREAT STEAMERS OF LONG ISLAND SOUND.

*By William A. Fairburn.*

THERE is a magnificent fleet of passenger-vessels now navigating our numerous lakes, sounds, and rivers, of which by far the most interesting and important are the steamboats engaged in the "Long Island sound" trade. They are not only unequaled, but even unapproached, in the world, for size, safety, capacity, and speed; for magnificence of decoration, perfect comfort, and luxury of appointment. Soon after Fulton had proved the practicability of steam-propulsion on the Hudson river, he turned his attention to the navigation of Long Island sound, which at that period was considered very hazardous. Accordingly the Fulton was built in the early part of 1814, and on March 21, 1815, she made her first trip on Long Island sound,—being the first steam-vessel to navigate those waters. The Fulton depended on her sails to accelerate her speed, and her first trip to New Haven was accomplished in 11 hours, the return being made in 15 hours, in foggy weather.

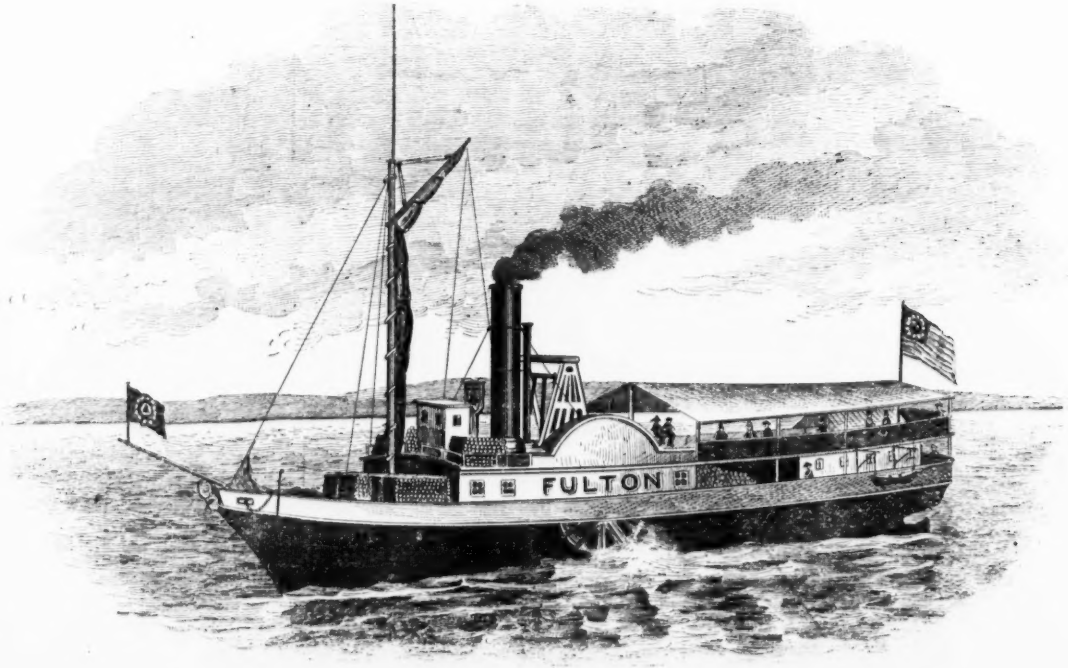
On May 25, 1817, the Hudson river steamboat Fire-Fly made the trip up the sound from New York to Newport in 28 hours, —the first steam-vessel to round Point Judith.

In 1818 the Connecticut appeared on the New Haven route, and continued to run until May, 1822.

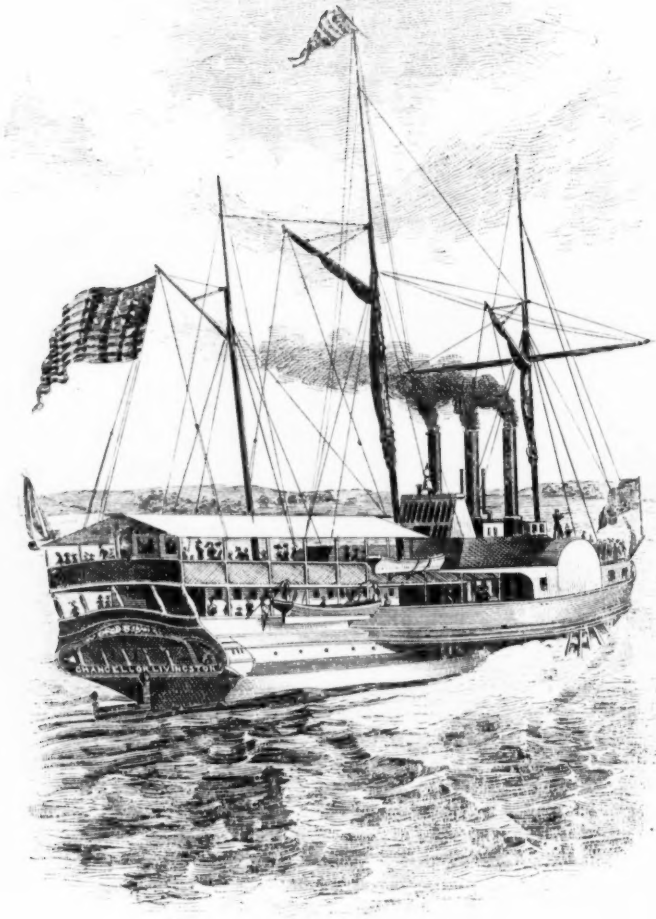
During November, 1821, a New Haven syndicate purchased the steamboat United States, which lay in New Jersey in an unfinished condition, and this vessel became the nucleus of the present New Haven Steamboat Company.

About this time the prohibitory laws of New York State forbade the passing through her waters of any boat propelled by steam other than the Fulton-Livingstone vessels; so the United States was towed to the sound by the sloop Huntress. On June 1, 1822, she made her first trip to Byran Cove, which was on the boundary line between New York and Connecticut, and passengers were then transferred to stages, to finish the journey on land,—a drive of 25 miles.

These trips were continued nearly 2 years, and when, in the spring of 1824, the final decision of the famous case "Gibbons vs. Ogden" was rendered, reversing a decision in the court of errors and declaring the act of the New York legislature, in granting exclusive right of steam navigation to Fulton and Livingstone, unconstitutional, the vessel began




FULTON, 1815.




CHANCELLOR LIVINGSTON, 1828.

regular trips direct to New York city. While the Fulton-Livingstone Co. held the monopoly of steam navigation in New York waters, the Connecticut legislature retaliated by refusing to admit the vessels of this company to steam in their waters. So in 1822 the Fulton and Connecticut had to leave the New Haven Line.

The Fulton, in August, 1821, made an excursion to Providence, and on June 6, 1822, the Connecticut and Fulton established the first line between New York, Newport, and Providence.

In 1825 a great step in advance in sound steamboats was made by the appearance of the Washington. She is said to have been the first boat fitted with a double engine. The *Providence Journal* of March 16, 1825, described her as "a floating palace, combining all the elegance of naval architecture with the most luxurious accommodation."

In 1827 the Marco Bozzaris commenced making trips between Dighton and New York, but she did not stay on the route long, as the opposition was too strong. In March, 1828, the Chancellor Livingstone appeared on the Providence route. In September the Benj. Franklin made her maiden trip, and on November 7, 1829, the famous President joined the line.

The *Providence Journal* said of her: "What further improvements yet remain to be made in steamboats we cannot imagine; to us and our generation the President must appear the *ne-plus-ultra*." The President was the first boat to be fitted with state-rooms; she had no sail.

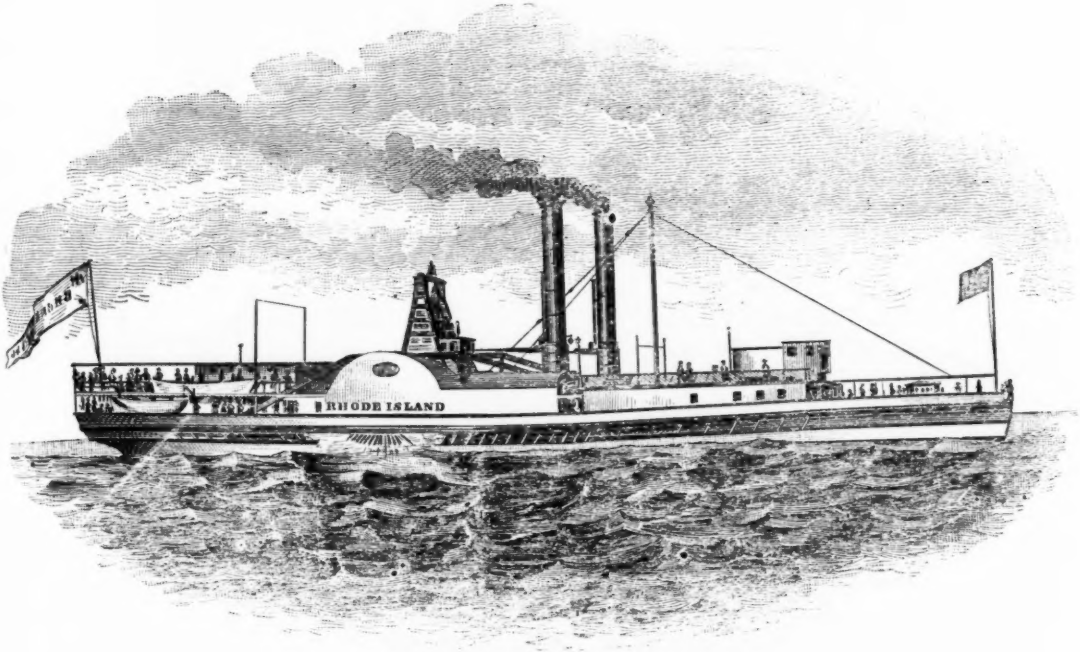
In 1831 the Boston commenced making trips up the sound; she was the first steamboat built without a mast. In 1832 the Providence appeared on the New Haven Line, and later on the Providence route. She was of 350 tons burden, and had a beam engine,— the first seen on the sound.

The old Connecticut made her last appearance in 1833, and in 1834 the Chancellor Livingstone was sunk in Boston harbor. In June, 1835, the famous Lexington made her first trip up the sound.

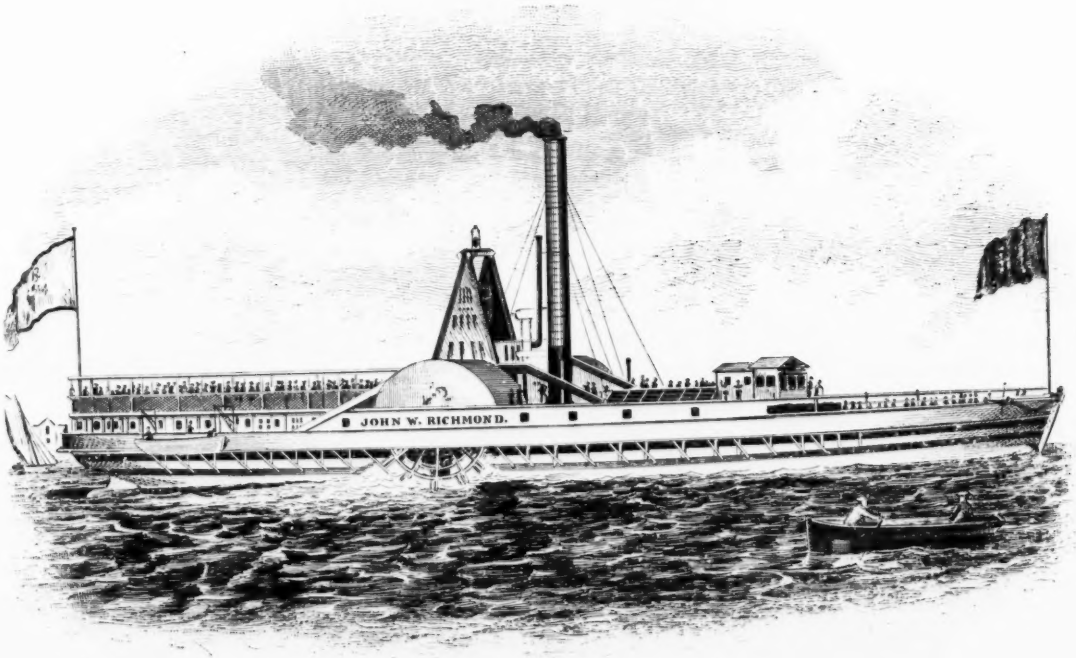
The next great step in advance was made a year later by the appearance of the Massachusetts, Rhode Island, and Narragansett. These boats were the first that in any way approximated modern steamboat architecture, and they were all much larger and better equipped than their predecessors.

The Boston was sold in 1838, and the President and Franklin made irregular trips until 1839; but their glory was fast waning, and they ultimately degenerated into coal-barges.

The railroad cars began to connect with the steamboats at Providence in June 15, 1835, and therefore the through line, New York to Boston, with steam as a motive-power, was formed. On November




RHODE ISLAND, 1836.




JOHN W. RICHMOND, 1837.

10, 1837, the Providence and Stonington Railroad was opened, and the Rhode Island and Narragansett at once made Stonington their terminus. In 1837 the John W. Richmond of the Atlantic Steamboat Company appeared on the route. At first her boilers were placed on deck, but, when one day she capsized at her wharf, it was thought advisable to put them below. She was sold in 1840 for $52,500, and plied on the Kennebec until burned in 1843. The Eureka made her first trip up the sound in 1840, and on January 13 of the same year the Lexington was burned at sea, off Huntington, Long Island; one hundred and five lives were lost.

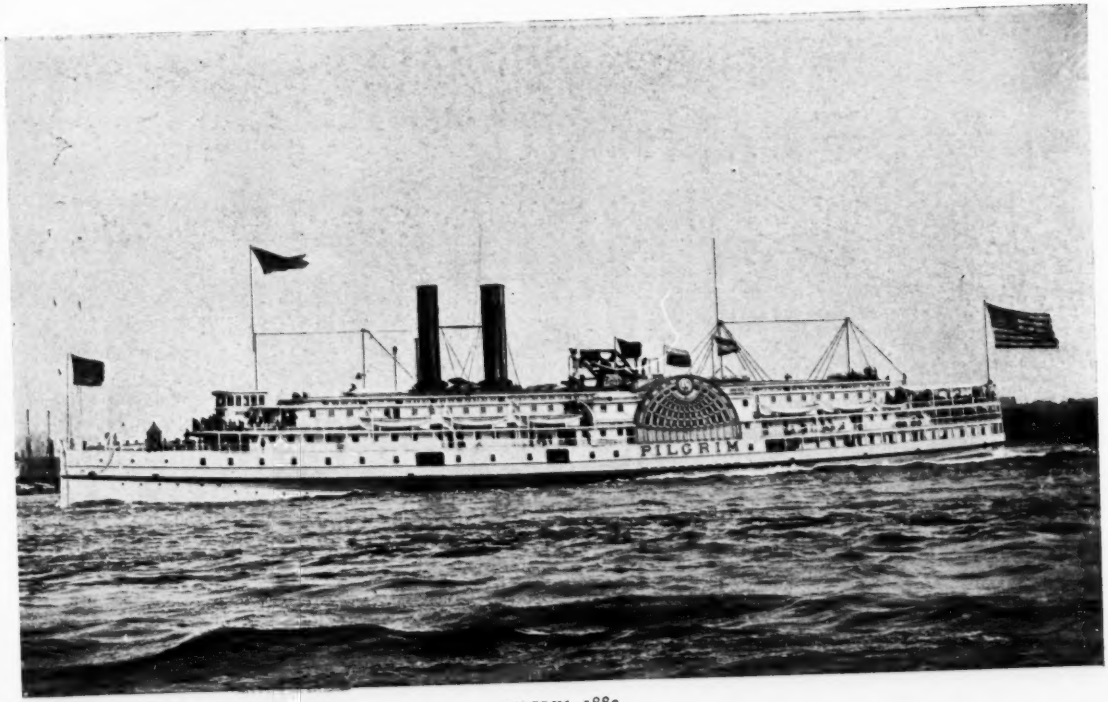
At this period the Providence line was beginning to lose its importance, and passenger travel was inclined to go by the way of the inside routes. In 1847 the well-known Connecticut (No. 2) appeared on the New Haven route; she proved a popular, speedy vessel, and had an engine with a 75-in. cylinder and 144-in. stroke. The same year the Fall River Line to Boston was inaugurated by the Bordens of Fall River. The boats were now withdrawn from the direct Providence route, and the Narragansett and Rhode Island were sold, went south, and were finally lost at sea.

The Fall River Line commenced with the Eudora, built in 1845; then came the Bay State, the finest specimen of marine construction of her class, in her day. The Empire State appeared in 1848, and in 1854 the well-known Metropolis joined the line. This vessel was for many years the queen and greyhound of the sound, and she was the first boat braced with diagonal iron truss work.

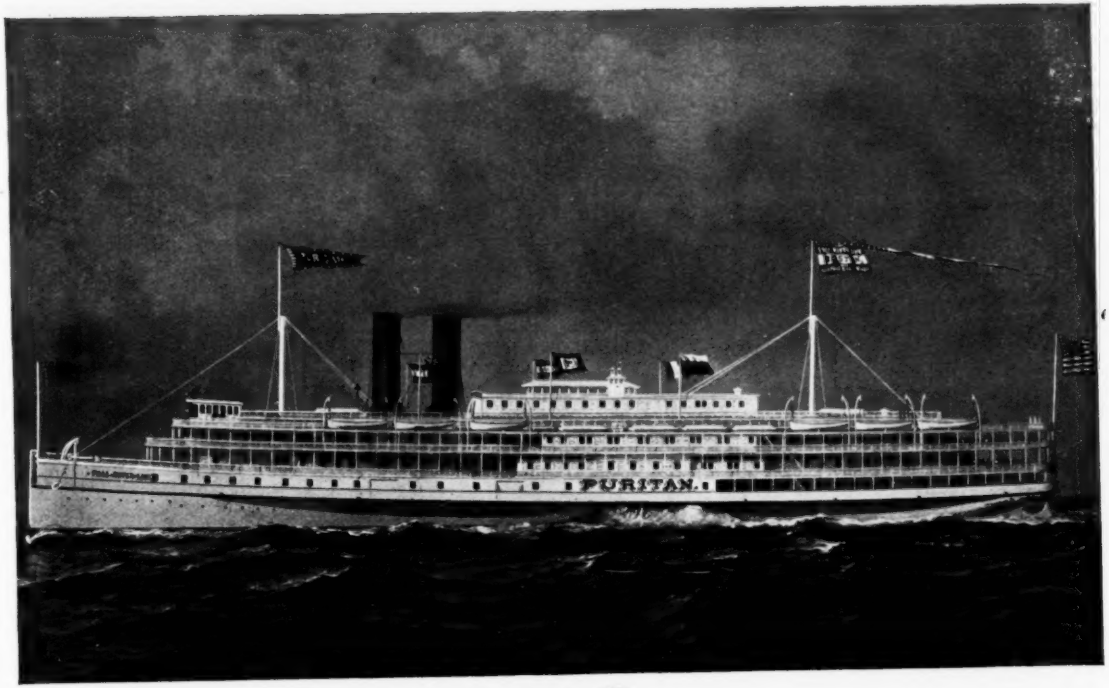
In 1864 Newport was made the eastern terminus for the Fall River Line boats, but in 1869 the terminus was again established at Fall River. In 1865 the Newport and Old Colony were built, and in 1867 the Bristol and Providence were added to the line. The latter vessels achieved a world-wide reputation for comfort, speed, and elegance, and the Providence still remains as one of the largest vessels on the sound.

In 1851 the Commercial Steamboat Company was organized, and ran the propellers Pelican, 350 tons, Osceola, 177 tons, and Petrel, 267 tons, to Stonington; and in 1855 the company started a day line to New York, adding the Curlew and Westchester, and later the Albatross, Penguin, Falcon, Eagle, Seagull, and Kingfisher. In 1863 the Neptune Line was organized with the Warrior, 1500 tons, a side-wheeler, and a few years later the small propellers Electra, Galatea, Oceanus, Metis, Thetis, Doris, Nereus, Glaucus, and Neptune were put on the route.

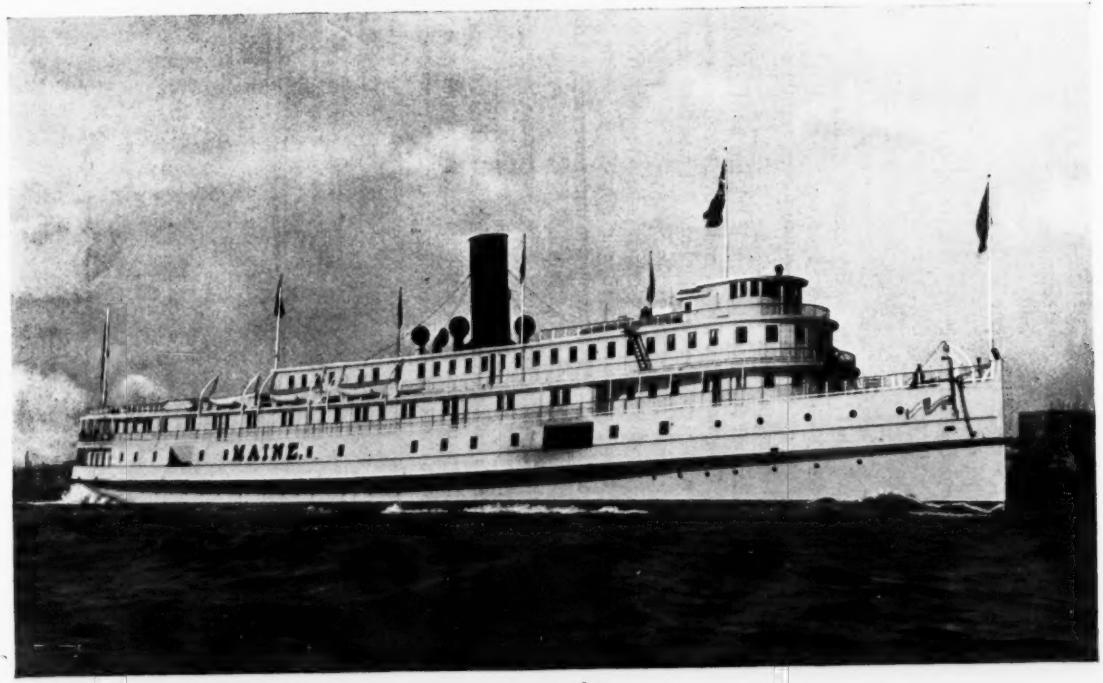
In 1864 the Commercial Line sold its boats to the Neptune Line, and in 1866 the Neptune and Stonington Line were consolidated, the




PILGRIM, 1883.




PURITAN, 1889.




MAINE, 1891.

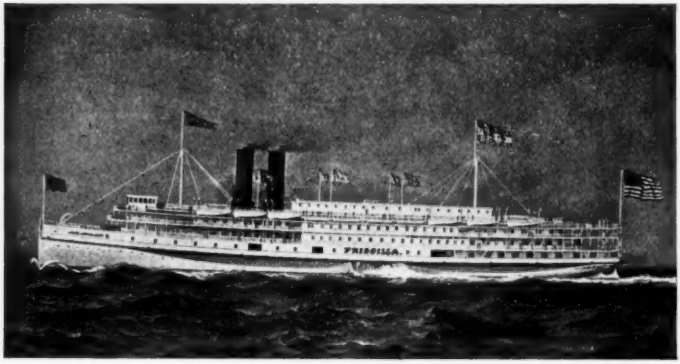
new line being known as the Merchants' Steamship Company. It added to the vessels owned by the Neptune Company the Commonwealth, Commodore, and Plymouth Rock; and Groton on the Thames was now made the terminus. Presently the company sustained heavy losses. First the Commonwealth, one of the most magnificent vessels on the sound, was burned at her wharf. She was a total loss, and was not insured. The docks being destroyed at Groton, the terminus was now changed to Stonington, and then the Commodore went ashore, and was a total loss. A little later the Plymouth Rock grounded at Saybrook, and was seriously damaged. The line was suspended, and the Bristol and Providence, then just being completed, and on which $1,350,000 had been spent, were sold for $360,000.

The Merchants' Steamship Company went to pieces, and the stockholders received but 3 cents on the dollar.

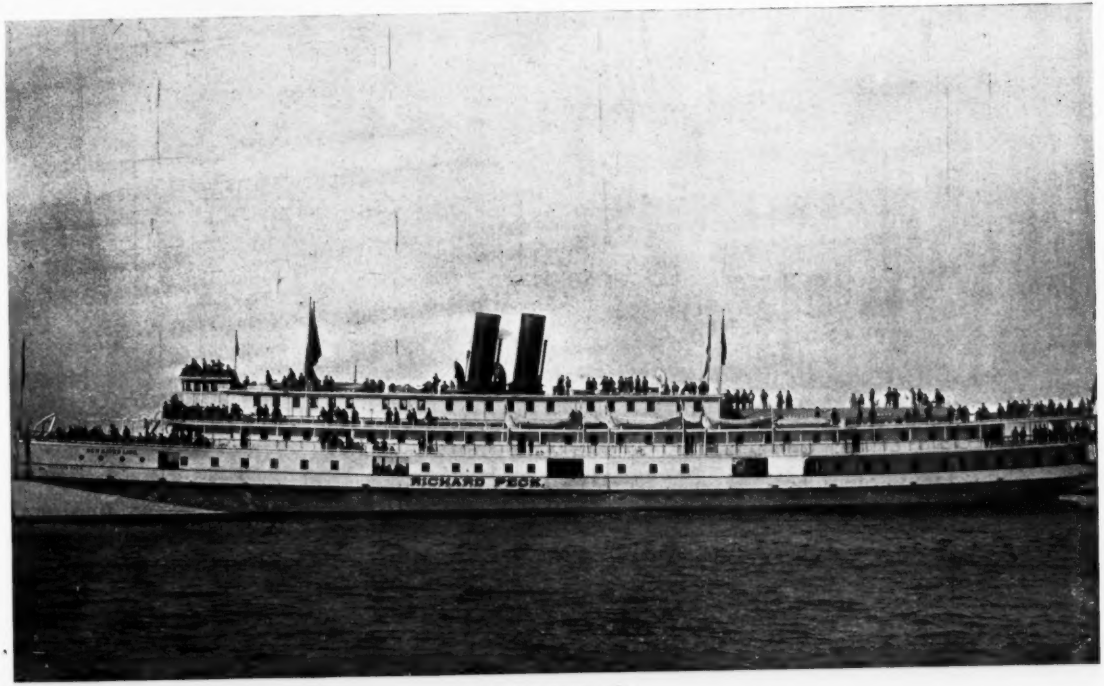
The Nereus, Glaucus, and Neptune were purchased by the Metropolitan Steamship Company; the Bristol and Providence finally went on the Fall River route; and the Neptune boats fell into the hands of the Providence and New York Steamboat Company.

In 1868 the Stonington Steamboat Company started again with the Narragansett and Stonington, and in 1875 it consolidated with the Providence Line, and both lines now operate under the name of the Providence and Stonington Steamship Company.

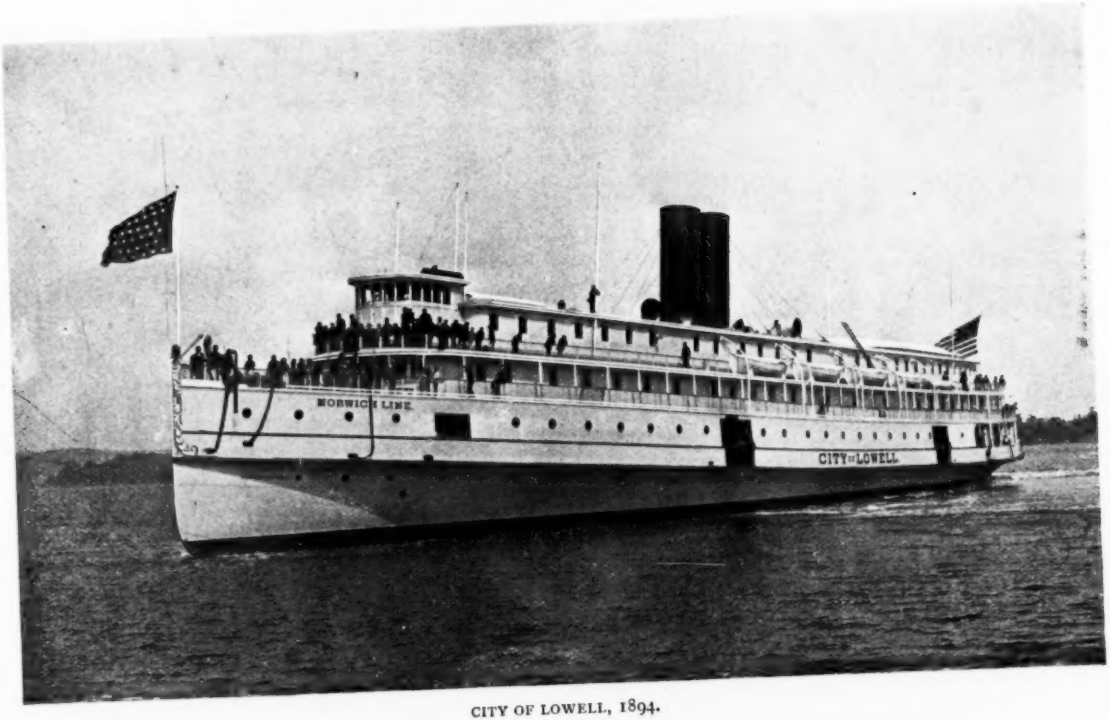
As before mentioned, the Fall River Line boats were joined in 1867 by the Bristol and Providence. It was at this time and for some years afterwards supposed that in these ships the limit of construction in steamboats of their class had been reached, so far as size and magnificence were concerned. Subsequent years have proved that they were little more than pioneers,—the merest prophecy of that



PRISCILLA, 1894.




RICHARD PECK, 1892.




CITY OF LOWELL, 1894.

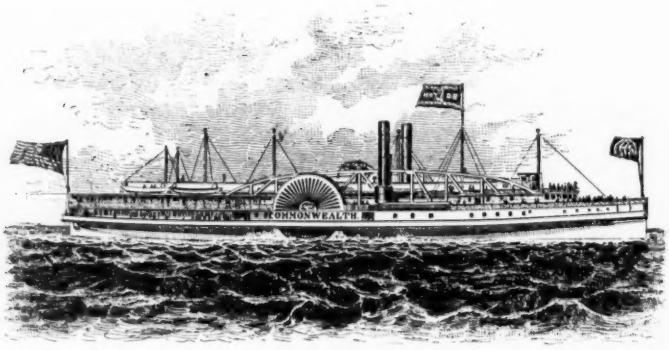
which was yet to be realized. They proved, however, the limit of construction in one direction; they are the largest wood passenger boats ever built for sound passenger transportation. In 1861 the Norwich Line for Boston was inaugurated, and since that time it has run the following vessels: City of Boston and New York in 1861; Norwich, 1862; New London, 1863; Lawrence, 1866; Worcester, 1881. The City of Norwich was sold in March, 1894, and the New London was burned November 21, 1871.

After the acquisition of the Bristol and Providence, 16 years elapsed before there was any further addition to the steamboats on the Fall River Line; but in 1881 the construction of the Pilgrim was commenced. She was launched the following year, and commissioned June 20, 1883. The Pilgrim far exceeded in size, capacity, and elegance any steamboat at that period afloat, and immediately upon her appearance in service she became known as the monarch of Long Island sound. She is built of iron, on the longitudinal bracket plate system, with a double bottom 36 in. in depth and minutely subdivided extending her whole length. The Pilgrim is worthy of especial notice, as she proved a pioneer in new directions in naval construction. She reduced many important and interesting theories to practice, and tested methods and appliances in her make-up that had theretofore existed only in the realms of experiment or proposed enterprise. Her machinery, electric plant, finishing, furnishings, etc., presented notable examples of progress.

That the Fall River Line owners were well pleased with the Pilgrim is doubtless true, but they were not entirely satisfied; and it soon became evident that a consort was needed. Accordingly in 1888 the Puritan was launched, and she was commissioned on June 17, 1889. The Puritan eclipsed the Pilgrim in every detail, thus showing the great improvement made in naval architecture during the previous 6 years. Upon her completion she at once took position before the world in accordance with her characteristics and qualifications, and therefore she immediately became the undisputed queen of the sound.

The Puritan is constructed of steel, and is undoubtedly a much handsomer vessel than the Pilgrim. In the first place, she has more freeboard, and this, with a neater sheer, gives her a more imposing appearance; then, again, the working beam in the more modern boat is cased in, the gaily ornamented paddle-boxes are done away with, and the compound engine is substituted for the unwieldly single-cylinder engine.

The Puritan was soon followed by the Plymouth, the latter vessel being launched in April, 1890, and commissioned in November of the same year. Although a trifle smaller than the Pilgrim and Puritan,




COMMONWEALTH, 1865.

this boat is very nearly identical with the latter in appearance and detail. She has, however, but one smoke-pipe and a four-cylinder inclined triple expansion engine.

But neither did the construction of these vessels, and their successful meeting of every expectation that had been centred upon them, satisfy the demands of the growing enterprise of the Fall River Line; and in June, 1894, a new boat, larger and more complete in every department than any that had preceded her, was placed on the route. She is known as the Priscilla.

From beginning to end the Priscilla is an artistic production, and this may be said without in the slightest degree detracting from the practical, and mechanical, in her make-up. Indeed, there is as much of the truly artistic in the arrangement of the great vessel, in the perfect working of her machinery, and in the correspondence of all her proportions, as there is in her ornamentations, decorations, and furnishings; howbeit, these last-named features were never excelled—probably were never equalled—in any vessel of her class.

The Priscilla stands to-day as the finest exponent of marine construction of her class in the world. As a passenger steamboat running upon an ocean route, characterized by the feature of both inside and outside navigation, she has no equal anywhere.

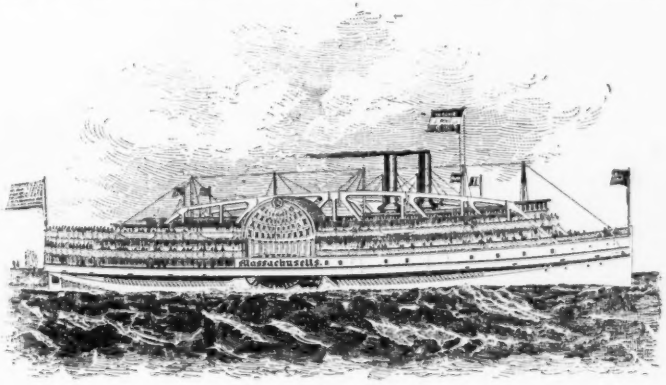
In the form of engine adopted in the Priscilla, the making of excessively large parts, such as the low-pressure cylinder and the beam engine would demand, is avoided, and the weight is kept easily below the safety-line. The double inclined engine, having practically no centers, lessens the vibration, and the vessel is in all respects exceeding steady.

One of the great features of the Priscilla is her strength of con-

struction. Mild steel enters into the construction of this boat in every part. In the saloon and cabins, behind, and concealed by the elaborate finish, steel trusses spring from the decks at either side, and span in unbroken arches overhead from side to side, a succession of vertebræ only a few feet apart. Steel carlins, stanchions, and braces are judiciously fitted to afford factors of strength and resistance, and the result is one of the stiffest and least impressible marine buildings ever floated.

The Massachusetts, 1876, and Rhode Island, 1882, have proved good and profitable vessels to the Providence Line, and in 1889 the Connecticut joined them. The Connecticut is a fine vessel, and is no doubt the last of the wood vessels to be built for passenger service on the sound. In shipbuilding it has always been understood that, the larger the vessel, the less is her intrinsic strength, all other things being equal. It was to overcome this practical defect in the science of naval construction that iron was introduced as a shipbuilding material, and only by its use has the mechanic been enabled to produce the large, successful, and heavily-powered steamships of modern times. The great trouble with the Connecticut has been her inability to carry the ponderous machinery fitted,—a fault we will find in all heavily-powered wooden vessels.

In 1891 the Maine and New Hampshire displaced the Stonington and Narragansett on the Stonington Line, and the side-wheeler, which had always held undisputed sway on the sound, was supplanted in these two steamers by the propeller. The fact that the power of these vessels is concentrated on one propeller necessitates the use of a fairly large wheel. As the boats draw but 12′ 6″ of water aft when loaded,



MASSACHUSETTS, 1876.

and as the propeller has a diameter of 13′ 6″, about 2 ft. of the tips of the blades is out of water, and this accounts for the great commotion noticeable around the stern when steaming.

In 1892 a new type of steamboat appeared,—*viz.*, the Richard Peck, of the New Haven Line. At that time the Puritan was the greyhound of the sound, but she soon had to give the pennant for speed to the new-comer, who defeated her by about 2 miles in a 56-mile run. The Richard Peck is a twin-screw steel steamboat, and she was designed by A. Cary Smith of New York. She is a very handsome craft, having splendid lines, with a fine, rakish, yacht-like appearance, and carrying a dainty, jaunty air.

When the Priscilla appeared in June last, she at once took the pennant and steamed majestically away from all her rivals; but this was not destined to last long, for a month later the steel twin-screw steamship City of Lowell of the Norwich Line came on the route. The Lowell was built by the Bath Iron Works of Bath, Me., and modelled by A. Cary Smith. She was designed as an improvement on the Richard Peck, and is a trifle larger, with more capacity, better finish, and greater speed. The lines and general smart appearance of the Peck were admired by all who saw her, but she does not compare with the Lowell in beauty and gracefulness. Immediately upon her com-

THE EARLY STEAMBOATS OF LONG ISLAND SOUND.

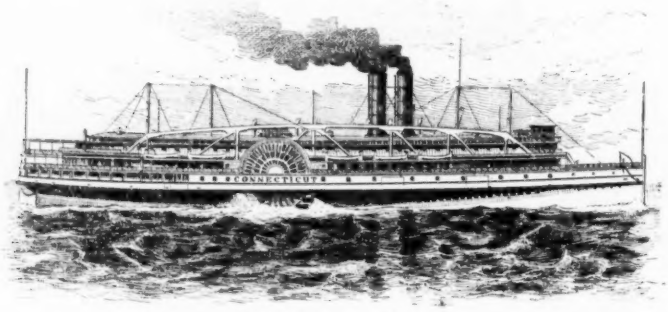
| Name. | Year Built. | Gross Tonnage. | Length. | Beam. | Depth Hold. | Speed Miles. |
|---|---|---|---|---|---|---|
| Fulton | 1815 | 327 | 134 | 26 | 10 | 7 |
| Connecticut | 1816 | 320 | 150 | 26 | 10 | 7.5 |
| Washington | 1825 | 530 | 180 | 30 | 10 | 8 |
| Chancellor Livingston | 1828 | 496 | 165 | 32 | 11 | 8.5 |
| Benj. Franklin | 1828 | 468 | 160 | 31.5 | 10 | 10 |
| President | 1829 | 615 | 183 | 32 | 11 | 13.5 |
| Lexington | 1835 | 475 | 205 | 22 | 11.5 | 14 |
| Massachusetts | 1836 | 676 | 202 | 29 | 12 | 13 |
| Rhode Island | 1836 | 588 | 212 | 28 | 10 | 13.5 |
| Narragansett | 1836 | 576 | 212 | 27 | 10 | 13.5 |
| John W. Richmond | 1837 | 480 | 200 | 24 | 12 | 14.5 |
| Bay State | 1848 | 1600 | 317 | 40 | 14 | 16 |
| Empire State | 1849 | 1600 | 317 | 40 | 14 | 16 |
| Metropolis | 1854 | 2108 | 342 | 45 | 15 | 18.5 |
| City of Boston | 1861 | 1577 | 301 | 40 | 12.3 | 19 |
| City of Norwich | 1862 | 997 | 200 | 36 | 13.2 | 15 |
| City of New London | 1863 | 1203 | 219 | 38 | 14 | 15 |
| Old Colony | 1864 | 1957 | 310 | 42 | 14.5 | 17.5 |
| Newport | 1865 | 2151 | 361 | 43 | 14.5 | 17.5 |
| City of Lawrence | 1866 | 1678 | 243 | 38 | 11.9 | 17 |
| Narragansett | 1866 | 1633 | 253 | 40 | 15 | 17 |
| Stonington | 1866 | 1633 | 253 | 40 | 15 | 17 |

## THE GREAT MODERN STEAMBOATS OF LONG ISLAND SOUND.

| Name of Vessel | Providence. | Massachus'ts. | C. H. Nort'm | City of Worc'r | Rhode Island. | Pilgrim. | Conn'cticut. | Puritan. | Plymouth | Maine. | New Ham're | Rich'rd Peck | Priscilla. | City of Lowell. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Material Constructed of | Wood. | Wood. | Wood | Iron. | Wood. | Iron. | Wood. | Steel. | Steel. | Steel. | Steel. | Steel. | Steel | Steel |
| Owners or Line | Fall River. | Providence. | New Haven. | Norwich | Providence. | Fall River. | Providence. | Fall River. | Fall River. | Stonington. | Stonington. | New Haven. | Fall River. | Norwich. |
| Designers { Hull | | Steers. | J Englis | H.& H. | J.Roach | J. Roach. | Mallory | G Pierce. | G. Pierce. | Ha'n & | Ha'n & | Smith. | Smith. | Smith. |
| Designers { Machinery | | J.Roach | Quint'd | Wilm'n | Noank. | Chester. | N. Y. | Fletcher. | Fletcher. | Holl'th | Holl'th | H & H. | H & H | C Hyde |
| Builders { Hull | | Gr'np't. | J Englis | H.& H. | Noank. | J. Roach. | Palmer. | J Roach. | J. Roach. | H.& H. | H.& H. | H.& H | Fletcher | B'th Ir |
| Builders { Machinery | | J.Roach | Quint'd | Wilm'n | Roach. | Chester. | Cramp. | Fletcher. | Fletcher. | Wilm'n | Wilm'n | Wilm'n | Del R I S | Works. |
| Date Completed | 1867 | 1877 | 1877 | Sept.'81 | May '82 | June20,'83 | June '89 | June 1889. | Nov. 1890 | Mar.'92 | Apr. '92 | Oct. '92 | June 1894. | July '94 |
| Estimated Total Cost | $680,000 | $400,000 | $375,000 | $430,000 | $410,000 | $1,220,000 | $560,000 | $1,225,000 | $900,000 | $385,000 | $385,000 | $435,000 | $1,500,000 | $465,000 |
| Gross Tonnage—C. H. M. | 2962 | 2607 | 1436 | 2490 | 2888 | 3484 | 3399 | 4593 | 3774 | 2395 | 2395 | 2906 | 5398 | 2975 |
| Net Tonnage—C. H. M. | 2064 | 2171 | 1179 | 1922 | 2387 | 2513 | 1872 | 3079 | 2280 | 1505 | 1505 | 1819 | | 1877 |
| Displacement | 3400 | 2600 | 1900 | 2250 | 3000 | 4200 | 3500 | 4150 | 3000 | 2000 | 2000 | 2300 | 4550 | 2368 |
| Length over all | 375′ | 340′ | 320′ | 345′ | 345′ | 390′ | 358′6″ | 410′4″ | 396′ | 310′ | 310′ | 315′ | 440′6″ | 336′01.2″ |
| Length. L. W. L. | 363′ | 324′ | 315′ | 328′ | 329′6″ | 375′ | 345′ | 403′4″ | 351′8″ | 302′-″ | 302′-″ | 300′ | 425′6″ | 319′10.3″ |
| Beam | 47′6″ | 46′ | 46′ | 46′ | 46′ | 50′ | 48′2″ | 52′6″ | 50′ | 44′ | 44′ | 48′ | 52′6″ | 49′6″ |
| Extreme Breadth over Guards | 84′6″ | 76′ | 80′ | 80′ | 84′ | 91′ | 87′0″ | 91′0″ | 87′ | 60′ | 60′ | 62′ | 93′ | 66′1″ |
| Mean Draft | 9′8″ | 10′0″ | 9′6″ | 10′3″ | 10′2″ | 11′8″ | 12′0″ | 11′8″ | 10′10″ | 10′6″ | 10′6″ | 10′6″ | 12′0″ | 12′6″ |
| Depth of Hold | 16′ | 16′4″ | 17′ | 16′6″ | 16′ | 18.3″ | 18′3″ | 18′1″ | 17′9″ | 17′6″ | 17′6″ | 17′6″ | 18′6″ | 17′2″ |
| Number of State Rooms. | | 185 | 112 | 159 | 165 | 230 | 209 | 360 | 250 | 102 | 102 | 135 | 396 | 164 |
| Passenger Berth Accommodation | | 360 | 595 | 519 | 334 | 700 | 528 | 920 | 710 | 240 | 240 | 520 | 1030 | 615 |
| Number of Crew or Complement | | 112 | 95 | 90 | 115 | 150 | 120 | 185 | 155 | 60 | 60 | 95 | 206 | 107 |
| Coal Capacity | | 129 | 50 | 125 | 120 | 80 | 130 | | | 80 | 80 | 60 | 200 | 90 |
| Freight Capacity | 500 | 357 | 430 | 425 | 455 | 550 | 552 | 700 | 600 | 500 | 500 | 530 | 800 | 600 |
| Mode of Propulsion | Side wh'ler. | Side wh'ler. | Side wh'ler. | Side wh'ler. | Side wh'ler. | Side wheeler. | Side wh'ler. | Side wheeler. | Side wheeler. | Single Screw. | Single Screw. | Twin Screw. | Side wheeler | Twin Screw. |
| Type of Engines | Vert. beam. | Vert. beam. | Vert. beam. | Vert. beam. | Comp. beam. | Single Cy Vert. B. | Comp. In. Os. | Co'p.S.C Vert. B'm | 4 cyl. d'le In. tr. ex. | 4 cyl. trip. ex. | 4 cyl. trip ex | Triple Expa'n | 4 cyl d'le Comp in | Triple Expa'n |
| Diameter of Cylinders | | 90″ | 80″ | 90″ | 64″-84″ x x 84″ 144″ | 110″ | 50½″-103″ | 75″x108″ | 47″ 75″ 81½″-81½″ | 28″-45″ 51″-51″ | 28″-45″ 51″-51″ | 24″-38″ 60″ | 51″-51″ 95″-95″ | 26″-40″ 64″ |
| Stroke | | 108″ | 144″ | 144″ | | 168″ | 121″ | 116″x168″ | 99″ | 42″ | 42″ | 30″ | 132″ | 36″ |
| I. H. P.—Maximum | 2800 | 2500 | 2200 | 3500 | 4000 | 5300 | 5000 | 7500 | 5500 | 3000 | 3000 | 4250 | 9800 | 4800 |
| Speed—Maximum | 16 | 17 | 17 | 18 | 17.3 | 18.5 | 18.5 | 21 | 19.5 | 19.3 | 19.3 | 21.5 | 21 8 | 23.4 |
| Cooling Surface in Condensers. | | 5753 | 6000 | 7170′ | 6500 | | 12,139′ | 15,000′ | 9959 | 4776 | 4776 | 6480′ | 16,000 | 6780′ |
| Type of Propeller | —— | —— | —— | —— | —— | —— | —— | —— | —— | 4 blades cast i'n | 4 blades cast i'n. | 4 blades cast i'n | —— | 4 blades M.br'ze |
| Propeller Diameter | —— | —— | —— | —— | —— | —— | —— | —— | —— | 13′6″ | 13′6″ | 10′6″ | —— | 11′6″ |
| Propeller Pitch | —— | —— | —— | —— | —— | —— | —— | —— | —— | 18′6″ | 18′0″ | 15′6″ | —— | 16′8″ |
| Blade Area of Each Wheel | —— | —— | —— | —— | —— | —— | —— | —— | —— | 60″ | 60″ | 42″ | —— | 47.52″ |
| Type of Paddle Wheels | | St'p B't | Radial | St'p B't | Radial. | | Feat'ng | Feath'ing | Feat'ring | —— | —— | —— | Feat'ring | —— |
| Diameter of Wheels | | 38′11″ | 36′ | 36′6″ | 34′ | 41′ | 28′ | 35′ | 30′ | —— | —— | —— | 35′ | —— |
| Width of Buckets | | 6′ | 10′6″ | 11′0″ | 6′8″ | | 13′ | 14′ | 13′3″ | —— | —— | —— | 14′ | —— |
| Depth of Buckets | | 2′4″ | 2′ | 2′4″ | 2′4″ | | 3′10″ | 5′ | 4″ | —— | —— | —— | 5′ | —— |
| Number of Main Boilers | | 6 | 2 | 4 | 5 | 12 | 6 | 8 | 8 | 4 | 4 | 6 | 10 | 6 |
| Type of Main Boilers | | ½ 2 St'l 4 4 ir'n Iron Scotch. | Return tubular | Redfield. | Steel Scotch. | Steel. | Steel gunb'at | Steel Redfield | Steel Scotch. | Steel Scotch. | Steel Scotch | Steel Scotch | Steel Scotch | Steel Scotch. |
| Length of Boilers | | 212″8′x13′ 211′x12′6″ | 24′ | 15′0″ | 36.20′ 26.10′ | | 20′3″ 6) 18′1″ 2) 19′0″ | | 13′1″ | 11′6″ | 11′6″ | 12′0″ | 14′6″ | 12′10″ |
| Diameter of Boilers | | 211′x11′6″ | 13′ | 17′6″ | 12′0″ | | 12′6″ | 6) 15′2″ 2) 14′0″ | 11′4″ | 13′6″ | 13′6″ | 13′0″ | 14′0″ | 13′6″ |
| Number of Furnaces | | 18 | 6 | 8 | 16 | | 18 | 16 | 16 | 12 | 12 | 18 | 30 | 18 |
| Grate Surface | | 472 | 260 | 472′ | 390′ | | 475 | 850′ | | 274′ | 274′ | 390′ | 850′ | 450′ |
| Heating Surface | | 7923 | 5000 | 13,675 | 12,480 | | 14,250 | 25,500 | | 7780 | 7780 | 11,500′ | 34,700 | 15,160′ |
| Working Pressure | | 35 lbs. | 40 lbs. | 52 lbs | 100 lbs. | 50 lbs. | 120 lbs. | 110 lbs. | 160 lbs. | 160 lbs. | 160 lbs | 160 lbs. | M.150 lbs | 165 lbs. |

mission the Bath-built boat commenced to show her speed, and all the boats she has encountered have been left far astern. On October 9, 1894, the Norwich Line owners resolved to have the vessel make a great record-breaking trip, and accordingly she left her wharf at North River at 5.33 p. m. and was moored at her dock in New London at 11.05 p. m., having made the trip of 122 statute miles in 5 hours and 32 minutes,—by far the quickest trip ever made up the sound. Her average speed from wharf to wharf was 22.04 miles per hour, and in the open sound her maximum speed was 23.4 miles. The vessel will soon be fitted with manganese bronze wheels, which, being much lighter, and of more pitch, will no doubt increase her speed. The sound boats built from A. Cary Smith's designs have many interesting features. First of all, they are the only twin-screw vessels on the sound, and are fitted with powerful triple expansion engines. They have each six boilers, and, as only five are in use at the same time, each of the boilers is cleaned every six weeks. Again the Peck and Lowell, although magnificent vessels, are built as cheaply and as substantially as possible. Everything on board is sound and first-class, and the materials and workmanship are of the best. But very little money has been spent for unnecessary interior decorations. The main saloon of the Lowell looks very pretty, being finished in delicate tints, well and tastefully ornamented with gold leaf. The furnishings are of the best, and the vessel has a solid, substantial look throughout. Nevertheless her interior cannot compare with those of the artistic Priscilla and the other modern Fall River boats. The Priscilla, however, cost about three times as much as the Lowell.

Another great feature of the twin-screw vessels is their great carrying capacity and economical steaming. Both the Peck and Lowell




CONNECTICUT, 1889.

carry more freight and passengers, using much less coal, and at the same time show better speed, than any vessel of the old type. The C. H. Northan, of the New Haven Line, built prior to the Peck, has been known as a great carrier and fast boat, but the Peck, 15 ft. shorter, carries ten car-loads more freight, and saves 18 tons of coal, per round trip. The City of Lowell carries nearly 50 per cent. more freight and one hundred more passengers than the City of Worcester of the same line, and the Lowell, making better speed, consumes but 48 tons of coal per round trip, whereas the Worcester consumes 87 tons.

A great feature of the Lowell is that she cuts through the water cleanly, leaving no turbulent wave behind her, and causing no high bow wave, thus proving the efficiency of the model, and the nearly complete utilization of power.

All the modern Fall River Line boats are fitted with a double bottom; in a word, they are unsinkable. They are built on the longitudinal system, and have high freeboard, so as to float when a large number of their watertight compartments are filled with water. Numerous instances could be cited, showing the value and proving the efficiency of the double bottom, when properly fitted; and the Pilgrim, Puritan, and Plymouth would all have been sunk, had they not been so constructed. A vessel fitted with a double shell has to be more stiff and rigid than a vessel not so fitted, as both the larger framing and the inner skin tend to give more strength, especially longitudinally, and this tends to reduce the vibration to a minimum.

Another great feature of the double bottom is that water ballast can be carried when desired, and the vessel can always be stable and trimmed well. The screw boats on the sound have no double bottom. This is a great defect. If any accident happens to them, they are in great danger. They have but little fore and aft strength, and even their scantlings for transverse strength are very light; this accounts for the vibration on some of these vessels, at times so excessive.

The ideal vessel for sound passenger transportation would be designed as follows: (1) Length and proportions sufficient to allow for good lines for economical propulsion, and capacity. Give the vessel a good rising floor and easy bilge, and what you lose in displacement you can gain by giving the vessel more beam than usual. (2) For vessels up to 6,000 or 6,500 h. p., the twin-screw mode of propulsion; above that power, three screws, on account of the light draft necessary. Engines to be of the vertical triple or quadruple expansion type, with excessive boiler power, so that each boiler can be in turn disconnected and cleaned. It is possible that water-tube boilers may be used, especially if quadruple expansion engines are adopted. (3) A double bottom

the whole length, on the longitudinal system, with good sub-division. The hull built out to the shafting aft, and the deadwood cut away forward, giving a rounding, easy sweep to the stern. Give the vessel a neat, yacht-like sheer, and a rakish, smart appearance, and put on as many decks as stability will allow.

Almost every new steamboat built since steamboats began to ply on the sound has been called the *ne-plus-ultra*. It would be rash to say even now that the limit has been reached. It is certain, however, that well-managed transportation companies will endeavor to keep their boats fully up to the expectation of the public ; but that the public are at present satisfied by the magnificent floating palaces recently constructed is evidenced by the great number of passengers that use them in preference to railroad trains, which also have reached a degree of comfort and luxury never before attained.

# PARKS, PARKWAYS AND PLEASURE-GROUNDS.

*By Frederick Law Olmsted.*

THE aggregation of men in great cities practically necessitates the common or public ownership, or control, of streets, sewers, water pipes, and pleasure-grounds. Municipal pleasure-grounds comprise all such public open spaces as are acquired and arranged for the purpose of providing favorable opportunities for healthful recreation in the open air. As there are many modes and means of open-air recreation, so there are many kinds of public pleasure-grounds. The formal promenade or plaza is perhaps the simplest type. Broad gravel-ways well shaded by trees afford pleasant out-of-door halls where crowds may mingle in an easy social life, the value of which is better understood in Southern Europe and in Spanish America than in the United States. Agreeable and numerous open-air nurseries and playgrounds for small children present a more complex, but perhaps more necessary, type of public ground. Very few public open spaces suitably arranged for this special purpose are to be found in American cities, and yet it goes without saying that every crowded neighborhood ought to be provided with a place removed from the paved streets, in which mothers, babies, and small children may find opportunity to rest and sleep and play in the open air. Playgrounds for youths are needed, but these may be further removed from the crowded parts of towns. Public open-air gymnasia have proved valuable in Europe and in Boston. Public flower-gardens are sometimes provided, but these are luxuries, and ought to be opened at the public expense only after the more essential kinds of public grounds have been secured. Promenades, gardens, concert-grounds, out-door halls, nurseries, playgrounds, gymnasia, and gardens may, of course, be combined one with another, as opportunity offers. To properly fulfil their several functions none of them need take out more than a small space from the income-producing area of a town.

There remains another less obvious, but very valuable, source of refreshment for townspeople, which only considerable areas of open space can supply. The well-to-do people of all large towns seek in travel the recreation which comes from change of scene and contemplation of scenery. For those who cannot travel, free admission to the best scenery of their neighborhood is desirable. It is, indeed, necessary, if life is to be more than the meat. Cities are now grown so great that hours are consumed in gaining the "country," and, when the fields are reached, entrance is forbidden. Accordingly it becomes

necessary to acquire, for the free use and enjoyment of all, such neighboring fields, woods, pond-sides, river-banks, valleys, or hills as may present, or may be made to present, fine scenery of one type or another. This providing of scenery calls for the separation of large bodies of land from the financially productive area of a town, county, or district; and, conversely, such setting apart of large areas is justifiable only when "scenery" is secured or made obtainable thereby.

Having thus made note of the main purposes of public pleasure-grounds, we pass now to consider (1) Government; (2) Sites and Boundaries; (3) General Plans or Designs; and (4) Construction.

### PARK GOVERNMENT.

The providing and managing of reservations of scenery is the highest function and most difficult task of the commissioners or directors of park works. Public squares, gardens, playgrounds, and promenades may be well or badly constructed, but no questions are likely to arise in connection therewith which are beyond the comprehension of the ordinary man of affairs. If scenic parks, on the other hand, are to be well placed, well bounded, well arranged, and, above all, well preserved, the directors of the work need to be more than ordinary men. Real-estate dealers must necessarily be excluded from the management. Politicians, also, if the work is to run smoothly. The work is not purely executive, like the work of directing sewer-construction or street cleaning, which may best be done by single responsible chiefs. The direction of park works may probably best rest with a small body of cultivated men, public-spirited enough to serve without pay, who should regard themselves and be regarded as a board of trustees, and who, as such, should make it their first duty to hand down unharmed from one generation to the next the treasure of scenery which the city has placed in their care. Public libraries and public art museums are created and managed by boards of trustees. For similar reasons public parks should be similarly governed.

A landscape park requires, more than most works of men, continuity of management. Its perfecting is a slow process. Its directors must thoroughly apprehend the fact that the beauty of its landscape is all that justifies the existence of a large public open space in the midst, or even on the immediate borders, of a town; and they must see to it that each newly-appointed member of the governing body shall be grounded in this truth. Holding to the supreme value of fine scenery, they will take pains to subordinate every necessary construction, and to perfect the essence of the park, which is its landscape, before elaborating details or accessories, such as sculptured gates or gilded fountains, however appropriately or beautifully they may be designed. As

trustees of park scenery, they will be especially watchful to prevent injury thereto from the intrusion of incongruous or obtrusive structures, statues, gardens (whether floral, botanic, or zoologic), speedways, or any other instruments of special modes of recreation, however desirable such may be in their proper place. If men can be found to thus serve cities as trustees of scenic or rural parks, they will assuredly be entirely competent to serve at the same time as providers and guardians of those smaller and more numerous urban spaces in which every means of recreation, excepting scenery, may best be provided.

PARK SITES AND BOUNDARIES.

It is much to be desired that newly-created park commissions should be provided at the beginning, by loan or otherwise, with a supply of money sufficient to meet the cost of all probably desirable lands. Purchases or seizures of land should be made as nearly contemporaneously as possible. Before making any purchases, ample time should, however, be taken for investigation, which should be directed both to the study of the scenery of the district in question and to a comparison of land values. The first problem usually is to choose from the lands sufficiently vacant or cheap to be considered (1) those reasonably accessible and moderately large tracts which are capable of presenting agreeable secluded scenery, and (2) those easily accessible or intervening small tracts which may most cheaply be adapted to serve as local playgrounds or the like. A visit and report from a professional park-designer will prove valuable, even at this earliest stage of operations. Grounds of the local playground class may safely be selected in accordance with considerations of cheapness and a reasonably equitable distribution, but the wise selection of even small landscape parks requires much careful study. It is desirable that a city's parks of this class should present scenery of differing types. It is desirable that the boundaries of each should be so placed as to include all essential elements of the local scenery and to produce the utmost possible seclusion and sense of indefinite extent, as well as to make it possible to build boundary roads or streets upon good lines and fair grades. Public grounds of every class are best bounded by streets; otherwise, there is no means of insuring the desirable fronting of buildings towards the public domain. In spite of a common popular prejudice to the contrary, it will generally be found that concave, rather than convex, portions of the earth's surface are to be preferred for park-sites. If the courses of brooks, streams, or rivers can be included in parks, or in strips of public land connecting park with park or park with town, several advantages will be secured at one stroke. The natural surface-drainage channels will be retained under public control where

they belong; they will be surely defended from pollution; their banks will offer agreeable public promenades; while the adjacent boundary roads, one on either hand, will furnish the contiguous building land with an attractive frontage. Where such stream-including strips are broad enough to permit the opening of a distinctively pleasure drive entirely separate from the boundary roads, the ground should be classed as a park. Where the boundary roads are the only roads, the whole strip is properly called a parkway; and this name is retained even when the space between the boundary roads is reduced to lowest terms and becomes nothing more than a shaded green ribbon, devoted perhaps to the separate use of the otherwise dangerous electric cars. In other words, parkways, like parks, may be absolutely formal or strikingly picturesque, according to circumstances. Both will generally be formal when they occupy confined urban spaces bounded by dominating buildings. Both will generally become picturesque as soon as, or wherever, opportunity offers.

After adequate squares and playgrounds, two or three local landscape parks, and the most necessary connecting parkways shall have been provided, it may next be advisable to secure one or more large parks, or even one or more reservations of remoter and wilder lands. In a city of five hundred thousand inhabitants a park of five hundred acres, however judiciously located, is soon so much frequented as necessarily to lose much of its rurality; in other words, much of its special power to refresh and charm. The necessarily broad roads, the numerous footways, the swarms of carriages and people, all call to mind the town, and in a measure offset the good effect of the park scenery. It is then that it becomes advisable to go still further afield, in order to acquire and hold in reserve additional domains of scenery, such as Boston has lately acquired in the Blue Hills and the Middlesex Fells. In selecting such domains, however, no new principles come into play. As in selecting sites for parks, so here it is always to be borne in mind that provision and preservation of scenery is the purpose held in view, and that demarcation of acquired lands is to be determined accordingly.

### PARK PLANS OR DESIGNS.

To "plan" something means to devise ways of effecting some particular purpose. It has not always been thought necessary to "plan" the various kinds of pleasure-grounds. With no consistent end or purpose in mind, the members of some park commissions attempt to direct from day to day and from year to year such "improvements" as they may from time to time decide upon. That the results of this method of procedure are confused, inadequate, and unimpressive is not to be wondered at.

In order to be able to devise a consistent plan, such as may be followed during a long period of years with surety that the result will be both useful and beautiful, it is necessary, in the first place, to define as accurately as possible the ends or purposes to be achieved. As already remarked, these ends or purposes are as numerous as are the various modes of recreation in the open air. Thus a small tract of harbor-side land at the North End of Boston has been acquired by the park commission, in order to supply the inhabitants of a poor and crowded quarter with a pleasant resting-place overlooking the water, and with opportunities for boating and bathing. Accordingly, the plan provides a formal elevated stone terrace, connecting by a bridge spanning an intervening traffic-street with a double decked pleasure-pier, which in turn forms a breakwater enclosing a little port, the shore of which will be a bathing beach. In the adjacent city of Cambridge a rectangular, level, and street-bounded open space has been ordered to be arranged to serve as a general meeting-place or promenade, a concert-ground, a boys' playground, and an out-door nursery. Accordingly, the adopted plan suggests a centrally-placed building which will serve as a shelter from showers and as a house of public convenience, in which the boys will find lockers and the babies a room of their own, from which also the head keeper of the ground shall be able to command the whole scene. South of the house a broad, but shaded, gravel space will provide room for such crowds as may gather when the band plays on a platform attached to the veranda of the building. Beyond this concert-ground is placed the ball-field, which, because of the impossibility of maintaining good turf, will be of fine gravel firmly compacted. Surrounding the ball-ground and the whole public domain is a broad, formal, and shaded mall. At one end of the central building is found room for a shrub-surrounded playground and sand-court for babies and small children. At the other end of the house is a similarly secluded out-door gymnasium for girls. Lastly, between the administration house and the northern mall and street, there will be found an open lawn, shut off from the malls by banks of shrubbery and surrounded by a path with seats where mothers, nurses, and the public generally may find a pleasant resting-place.

Plans for those larger public domains in which scenery is the main object of pursuit need to be devised with similarly strict attention to the loftier purpose in view. The type of scenery to be preserved or created ought to be that which is developed naturally from the local circumstances of each case. Rocky or steep slopes suggest tangled thickets or forests. Smooth hollows of good soil hint at open or "park-like" scenery. Swamps and an abundant water-supply suggest ponds, pools, or lagoons. If distant views of regions outside the park are

likely to be permanently attractive, the beauty thereof may be enhanced by supplying stronger foregrounds; and, conversely, all ugly or town-like surroundings ought, if possible, to be "planted out." The paths and roads of landscape parks are to be regarded simply as instruments by which the scenery is made accessible and enjoyable. They may not be needed at first, but, when the people visiting a park become so numerous that the trampling of their feet destroys the beauty of the ground cover, it becomes necessary to confine them to the use of chosen lines and spots. These lines ought obviously to be determined with careful reference to the most advantageous exhibition of the available scenery. The scenery also should be developed with reference to the views thereof to be obtained from these lines. This point may be illustrated by assuming the simplest possible case,—namely, that of a landscape park to be created upon a parallelogram of level prairie. To conceal the formality of the boundaries, as well as to shut out the view of surrounding buildings, an informal "border plantation" will be required. Within this irregular frame or screen the broader the unbroken meadow or field may be, the more restful and impressive will be the landscape. To obtain the broadest and finest views of this central meadow, as well as to avoid shattering its unity, roads and paths should obviously be placed near the edges of the framing woods. In the typical case a "circuit road" results. It is wholly impossible to frame rules for the planning of rural parks; local circumstances ought to guide and govern the designer in every case; but it may be remarked that there are few situations in which the principle of unity will not call for something, at least, of the "border plantation" and something of the "circuit road."

Within large rural parks economy sometimes demands that provision should be made for some of those modes of recreation which small spaces are capable of supplying. Special playgrounds for children, ball or tennis grounds, even formal arrangements such as are most suitable for concert-grounds and decorative gardens, may each and all find place within the rural park, provided they are so devised as not to conflict with or detract from the breadth and quietness of the general landscape. If boating can be provided, a suitable boating-house will be desirable; the same house will serve for the use of skaters in winter. In small parks economy of administration demands that one building should serve all purposes and supply accommodations for boating parties, skaters, tennis-players, ball-players, and all other visitors, as well as administrative offices. In large parks separate buildings serving as restaurants, boat-houses, bathing-houses, and the like may be allowable. It is most important, however, to remember that these buildings, like the roads and paths, are only subsidiary,

though necessary, adjuncts to the park scenery; and, consequently, that they should not be placed or designed so as to be obtrusive or conspicuous. Large public buildings, such as museums, concert halls, schools, and the like, may best find place in town streets or squares. They may wisely perhaps be placed near, or facing upon, the park, but to place them within it is simply to defeat the highest service which the park can render the community. Large and conspicuous buildings, as well as statues and other monuments, are completely subversive of that rural quality of landscape the presentation and preservation of which is the one justifying purpose of the undertaking by a town of a large public park.

### PARK CONSTRUCTION.

That the man who thinks out the general plan of a park ought to have daily supervision of the working-out of that plan is undoubtedly theoretically true. It is impossible to represent in drawings all the nice details of good work in grading and planting, and yet no work is more dependent for its effect upon finishing touches.

On the other hand, however desirable the constant oversight of the landscape architect may be, it is impracticable under modern conditions. The education of a designer of parks consumes so much time, strength, and money that no existing American park commission, unless it be that of New York, can as yet afford to engage the whole time of a competent man. Consequently, it is the usual practice for the landscape architect to present his design in the form of a drawing or drawings, and to supplement the drawings by occasional visits for conference with those in immediate charge, by descriptive reports, and by correspondence.

The prime requisite in the resident superintendent of park work is efficiency. Naturally enough, most of the superintendents of parks in the United States have been trained either as horticulturists or as engineers, but it is not necessary or even desirable that such should be the case. Probably the best results will be achieved by men who, possessing the organizing faculty and a realizing sense of the importance of their work, shall, with the assistance of an engineer and a plantsman, labor to execute faithfully designs which they thoroughly understand and approve.

Most men of specialized training, such as architects, engineers, and all grades of horticulturists, stand in need of an awakening before they are really competent to have to do with park work. Each has to learn that his building, his bridge or road, his tree or flower, which he has been accustomed to think of as an end in itself, is, in the park, only a means auxiliary and contributive to a larger end,—namely, the

general landscape. It is hard for most gardeners to forego the use of plants which, however lovely or marvellous they may be as individuals, are only blots in landscape. It is hard for most engineers to conform their ideas of straightforward construction to a due regard for appearance and the preservation of the charm of scenery. Neatness of finish in slopes adjacent to roads is not sufficient; such slopes must be contrived so as to avoid formality and all likeness to railroad cuts or fills. Road lines and grades which may be practicable in the ordinary world are to be avoided in the park, because the pleasure of the visitor is the one object held in view. Roads, walls, bridges, water-supply, drainage, and grading,—such of these works as may be necessary are to be executed with all technical skill, as in the outer world; but the engineer in charge should be a man who will see to it that the work is done with constant regard to the object of a park as distinguished from the object of a city street or square or railroad.

Similarly, the park planter should be a man capable of holding fast to the idea that the value of a rural park consists in landscape, and not in gardening or the exhibition of specimen plants. Guided by this idea, he will avoid such absurd traces of formality as the too common practice of planting trees in rows beside curving driveways. In devising necessary plantations he will give preference to native plants, without avoiding exotics of kinds which blend easily. Thus, where a banana would be out of place, the equally foreign barberry, privet, or buckthorn may be admissible and useful. Influenced by the same principle, he will confine flower-gardening to the secluded garden, for which space may perhaps be found in some corner of the park.

If men can be found who will thus coöperate with park commissioners to the end that the lands and landscapes which the latter hold in trust shall be cared for and made available in strict accordance with that trust, excellent results can be hoped for in American parks. As before remarked, men who are capable of such work may certainly be trusted to construct and manage town spaces—squares, playgrounds, and the like—with due regard to their special purposes and to the satisfaction of all concerned.

# THE ILLUMINATION OF STREETS AND PUBLIC PLACES.

*By Franklin Leonard Pope.*

IT is said that in England the essential distinction between a village and a hamlet resides in the fact that the former contains a church edifice, while the latter does not; but that, when a village, in addition to one or more churches, can also boast of a public market, it may aspire to the dignity of a town. In our own country it would not be far wrong to say that, when a neighborhood has become of sufficient importance, in the estimation of its inhabitants, to justify the provision of a sidewalk and two or three street-lamps by voluntary public subscription, it has advanced to the status of a village, while the introduction of gas or electric lighting in its streets and places of business surely ought to entitle it to the distinction of being called a town.

In a growing village the first essay in the direction of public lighting usually consists in the establishment of a number of kerosene lamps. These are commonly enclosed in glass lanterns or globes, and set upon wooden posts 8 or 9 ft. in height, erected near the sidewalks at each street-intersection or other convenient place, usually at intervals of 500 ft., more or less. There is a certain disposition, in these days of universal electricity, to underestimate the utility of kerosene as a municipal illuminant; but it is none the less true that, when properly installed and intelligently managed, it is capable of furnishing a really excellent service at a moderate expense. Lanterns are now so constructed that the enclosed lights are not materially affected even by violent winds and storms, while by the use of oil, wicks, and chimneys of the best quality, and by conscientious care in cleaning and trimming, results may be attained little, if any, inferior to those usually realized from gas and electricity.

One of the most serviceable types of street-lamps for burning kerosene embodies the principle of the well-known "hurricane lantern," and has a 1 ¼-in. wick. When properly trimmed, it will give a light of from 15 to 20 candles, with an average consumption of less than 1 gill of good oil per hour, the cost of which will scarcely exceed 2 mills. The cost of the lamps themselves, including either turned wooden posts or ornamental iron brackets for convenient attachment to buildings or trees, will usually not be more than $5 each, when in place.

In attempting to light a village with kerosene, a common mistake is that of installing too few lamps, and not placing them sufficiently high

above the ground. A 60-ft. street cannot be well-lighted with lamps of this type, unless they are placed at intervals not much exceeding 250 ft. In built-up streets, having walks on both sides, the lamps should be situated between the walk and the roadway, alternating on opposite sides. In the central or business district, where the stores, churches, etc., are usually concentrated within a distance of a few hundred feet along the main thoroughfare, the interval between lamps may with advantage be reduced to about 125 ft. The lights should be at least 9 or 10 ft. above the level of the ground. In a country town of average compactness, it may safely be estimated that one lamp to each twenty-five inhabitants will suffice to provide a very satisfactory illumination of the thoroughfares, side-streets, and public places. The most economical and generally satisfactory plan of maintaining kerosene street-lights is to put the whole matter in the hands of a single responsible person, who should be able to clean, fill, and trim eight or ten lamps per hour, and to light twenty-five or thirty in an equal period of time. With a single assistant, starting an hour before sunset, one hundred lamps may be lighted before twilight. The cost of maintenance of course depends materially upon the number of hours the lamps are expected to burn in a year. If gaged to burn each night until after midnight, and left unlighted four or five moon-light nights in each month, according to the usual custom, perhaps 2000 hours per year may be taken as a fair average. This would consume about 40 gallons of oil, costing about $3; labor of filling and trimming, say $3 per year per lamp; renewals of chimneys, wicks, and other incidentals, say $1 more,—making a total of $7 per lamp per annum, which probably fairly represents the average cost in most village communities. With efficient and intelligent care, kerosene lamps may be made to light the streets, even of a large town, as brilliantly and effectively as by almost any known means, and at a comparatively modest expenditure.

For many years before the advent of electrical illumination the streets of nearly every municipality in the United States having five thousand or more inhabitants were lighted by gas. The burners most generally used were rated to consume 5 cu. ft. of gas per hour, and were assumed to give an illumination equal to 16 standard candles. At the time when the field of public lighting was first invaded by electric competition, the average price charged for gas for street-lamps was approximately $2 per thousand feet, equivalent to 1 cent per hour per lamp. Usually the gas company contracted to furnish everything, including labor of lighting and extinguishing, for a fixed sum per lamp, according to the schedule of hours of lighting agreed upon. A common price per year was $18 to $20 per lamp, on "moon schedule," or $25

to $30 for "all-night" lights. As a matter of fact, the street-lights under the gas *régime*, which in theory produced an illuminating effect of 16 candles, were too often in such a condition as to give not more than 10 or 12 candles, and the result as a whole scarcely compared favorably even with the kerosene lamp. A wide-spread dissatisfaction with the results of public gas-lighting existed in the community, which was often due, it is but fair to say, in no small degree to the absence of proper care and inspection on the part of the municipal authorities. This feeling of dissatisfaction had the effect of hastening the adoption of electricity for public lighting in many of the larger towns of the United States, within a very short period after the necessary apparatus had been placed upon the market in a commercial form.

Form of arc carbon tips. Current 45 volts and 10 amperes. (Full size.)

In medium-sized cities some use has been made of naphtha and gasoline lamps. These were introduced in the first instance as competitors of gas, having been found to give nearly as good illumination at considerably less cost. The general introduction of electricity, especially during the past 5 years, has largely diminished the use of devices of this character, and within a short time they will no doubt have completely disappeared.

The first attempt to illuminate a town by electricity was made at Wabash, Ind., in March, 1880. Arc lamps were used, two being placed upon the tower of the court-house and two more on a mast erected for the purpose. The trial run was witnessed by hundreds of visitors from all parts of the country. The plant, consisting of four lamps and the dynamo, is said to have originally cost $18,000. It was operated continuously for 6 years, after which it was taken down and ultimately sold for $30 as a historical curiosity. The first arc-lamps used, taking a current of about ten amperes, were denominated 2000-c. p. lamps; a meaningless and deceptive rating enormously in excess of their actual illuminating power, which, as recent investigations have shown, seldom exceeds one-fourth that amount. Although hundreds of thousands of arc-lamps have been used within the past 15 years for lighting the streets of American cities, they are by no means as well adapted to that purpose as their extensive use would lead one to suppose. A full-sized arc gives a brilliant and showy light, and a row of them imparts a decidedly metropolitan aspect to the streets of a small town or an ambitious suburban village; and it is perhaps for this, as much as any, reason that its popularity has always been greater than its intrinsic merit would seem to justify.

The light emitted by an arc-lamp is produced by the flow of the

electric current across a space of $\frac{1}{16}$ in. maintained between the ends of two rods of hard carbon, these being fed forward as fast as consumed, by simple mechanism controlled by the current itself. Minute particles of highly-heated carbon are thrown off from the upper or positive carbon, until its end forms itself into a concavity termed the crater; and it is from the intensely hot surface of this crater, the total area of which is scarcely $\frac{1}{10}$ sq. in., that at least four-fifths of the total illumination proceeds. The actual "arc" is a little cloud of luminous carbon vapor, golden-yellow in color with an axis of violet, and emits most of the remaining light visible to a spectator standing below the horizontal plane of the lamp; the comparatively small volume emanating from the lower carbon being mostly thrown upwards against the hood or reflector. This explains the very uneven distribution of light from the electric arc. Directly beneath the lamp is always a circular dark shadow 30 or 40 ft. in diameter; encircling this is a zone of brilliant light, the maximum intensity of which is found at a horizontal distance from the vertical axis of the lamp equal to its height above the ground. Beyond this zone of maximum illumination the effective light rapidly diminishes, until at a distance of some 300 ft. it is merged in the surrounding darkness. The greater portion of the light from each arc is projected downwards, at an angle of some 45° with the horizon. This irregularity of distribution is for many reasons undesirable in practice. For example, it is well recognized as dangerous by horsemen to drive rapidly at night through a street lighted only by arcs suspended above the roadway at somewhat wide intervals. The alternate areas of intense light and opaque shadow, and more especially the blinding glare of the arcs themselves when viewed at certain angles, frequently render it impossible for either horse or driver to discern an obstruction until too late to prevent an accident.

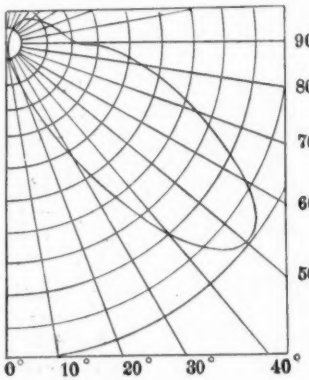
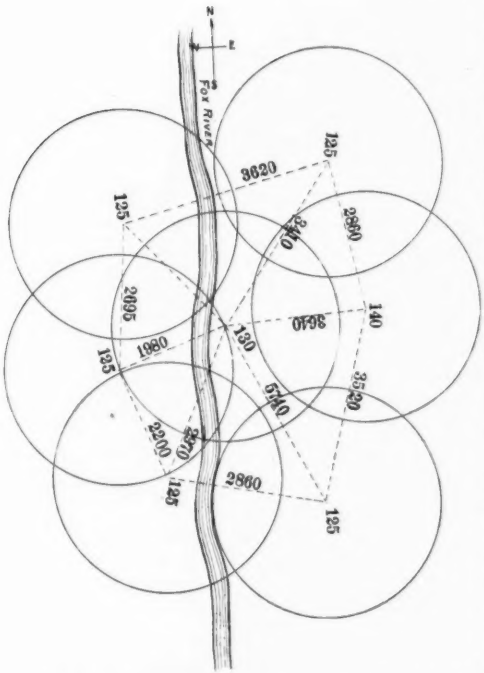



DIAGRAM SHOWING RELATIVE INTENSITIES OF LIGHT FROM DIRECT-CURRENT ELECTRIC ARC AT VARIOUS DEGREES OF INCLINATION TO THE HORIZON.

These objectionable peculiarities in the distribution of light from the electric arc early attracted the attention of electrical engineers, and led to a practice, at one time quite in favor, especially in western cities having broad streets with few high buildings or shade-trees, of grouping from four to eight arc-lamps in a corona upon the summit of a skel-




PLAN OF ARC LIGHTING BY TOWER SYSTEM IN ELGIN, ILL.

eton iron tower from 125 to 150 ft. in height, and providing the tower with an elevator by which an attendant could conveniently ascend to trim and adjust the lamps. As far as practicable, these towers were arranged at the intersections of a group of imaginary triangles, as many as five to seven towers being sometimes employed per square mile of area to be lighted. In a typical example of an installation of this kind, carried out some years since in Elgin, Ill., the central tower was 150 ft. high and carried five lamps; this was surrounded by six other towers, each 125 ft. in height and carrying four lamps. The towers were, roughly speaking, about half a mile apart. In this case the area lighted was about 4 sq. miles, and the population served about sixteen thousand. Such an arrangement, in a town adapted to its use, gives a very good distribution of light at a moderate expense, one of the marked advantages being the complete diffusion of the luminous rays, as made evident by the absence of the intensely black, sharply-defined shadows so noticeable when the lights are placed comparatively near the ground. For some years the tower system was in extensive use, but recently it has been largely superseded by other arrangements presently to be referred to.

Perhaps the most satisfactory plan of installing the arc-lamp under the conditions ordinarily found in American cities and towns is to suspend it from a device known as a "mast-arm," placed on one of

the corners at a street-intersection or other convenient location. A horizontal trussed iron arm is hinged to a bracket fixed to the top of an iron or wooden post. The lamp, with its protecting hood, hangs from the end of the cantilever about 20 or 25 ft. above the center of the roadway, and can be lowered to the ground, even when burning, for adjustment or recarboning. In streets more than 60 ft. in breadth the length of the mast-arm becomes somewhat inconvenient, and in such case recourse is usually had to a stranded steel cable, stretched diagonally across the street-intersection from supports placed at opposite corners, sustaining the lamp at a height of 30 to 35 ft. above the ground. The lamp may be lowered, when required, by means of a cord running through enclosed or "sleet-proof" pulleys.

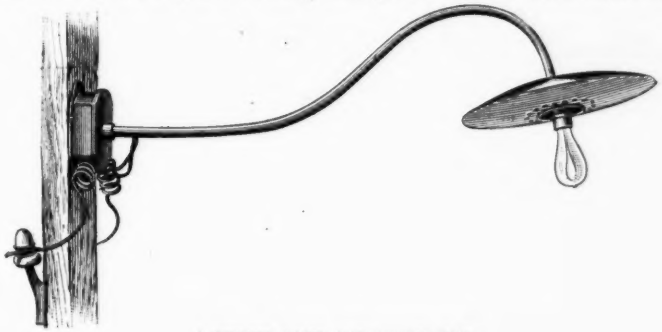
The standard arc-lamp is designed to operate with a difference of potential between its terminals of 45 to 50 volts, and for effective work requires a current of 9.5 to 10 amperes, so that the energy actually expended in each arc is approximately six-tenths of a horse-power. Dynamos are now made of capacities ranging from 3 to 150 lights. The greater the capacity of the dynamo, and consequently the greater the number of lamps operated in one series, the less the horse-power required per lamp. It is usual, for instance, to allow 20 h. p. at the central station to supply 25 standard lamps, but 80 h. p. is sufficient to operate one of the new model 125-light machines.

A smaller type of lamp, known as the "half-arc," nominally of 1200 c. p., has found an extensive sale and introduction, especially in ambitious communities of an economical turn of mind. The electrical engineer finds it a somewhat difficult matter to discover where the economy comes in. The half-arc takes a current of 6.8 amperes at the same potential as the full arc, and hence nearly 50 per cent. more lamps may be fed from a dynamo and engine of equal cost and capacity than when the standard arc is used. The half-arc usually gives an unsatisfactory light; at all events, the falling off in luminosity is considerably greater than the proportionate saving of fuel at the central station. The original cost of the smaller lamp, as well as the expense of line-construction, inspection, and maintenance, is practically the same as in the case of the standard lamp. Of course a town can be lighted with half-arcs after a fashion at a considerably less initial cost of central-station plant than with full arcs, but it is difficult for the expert to conceive of any conditions under which the latter would not prove more satisfactory from the outset, and more economical in the long run, than the former could possibly be.

Recent investigations prove that the quality of the carbons used in arc-lighting has a far greater influence upon the quantity and quality of the light than had hitherto been suspected. With a given expendi-

ture of energy, a difference of more than 50 per cent. in illuminating capacity was found to exist between different samples of commercial carbons purchased in open market and submitted to test.

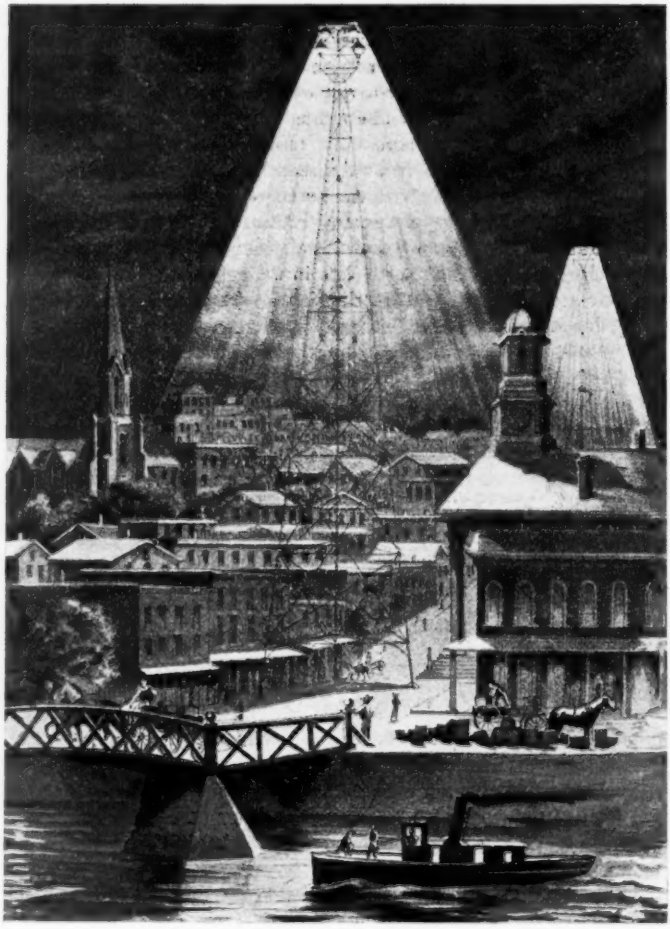
Arc-lamps have been extensively operated, and with a fair degree of success, by means of the alternating current. They are frequently connected, two in series, across the terminals of a 110-volt circuit, such as is often employed in both direct- and alternating-current distribution, thus dispensing with the necessity of a special circuit or even a special dynamo. The practical objections to this type of lamp are, however, serious. Not only is its total yield of light for a given expenditure of energy one-fourth less in the aggregate than that of the direct-current lamp, but its distribution is such as to render it particularly unsuitable for street-lighting; it is thrown upward as well as downward, and requires carefully-arranged reflectors to obtain from it



A STREET LAMP AND SHUNT BOX.

anything like a satisfactory illumination. The humming noise emitted by the alternating arc is peculiarly disagreeable, and in confined localities is sometimes very pronounced. All things considered, it does not at present appear probable that this type of lamp will ever find extensive acceptance in street-lighting as a substitute for the direct current arc.

The question as to what is an equitable price for public arc-lighting is one which has unfortunately received a vast amount of unintelligent discussion, and many comparative figures, which, if not actually false, are at all events utterly misleading, have been circulated in the newspapers. An analysis of a large volume of trustworthy statistics from various sources and representing various conditions leads to the conclusion that for a plant of say one hundred standard arcs operated by steam-power, doing no commercial lighting, the actual cost per lamp cannot, at present prices, be brought much below $100 per annum



ELECTRIC LIGHT TOWER.

for the all-night schedule of 4000 hours, or $65 per annum for a partial schedule of say 2200 hours, even assuming the best modern appliances and the most careful management. Every person conversant with such matters is well aware that the figures frequently paraded in the newspapers, purporting to show that municipalities owning and operating their own plants have been able to furnish themselves with

light at a cost materially less than that given above, are wholly untrustworthy. It may be safely affirmed that any municipality which is able to light its thoroughfares by contract with a private company at rates not more than 10 or 15 per cent. in advance of those given above has very little occasion to be dissatisfied with its bargain.

When the arc-lamp first began to be employed for public lighting, the incandescent lamp was still a thing of the future. Soon after the introduction of the latter into commercial use in 1880, some attempts were made to use it for street-lighting. The early incandescent lamps were, however, little, if any, superior in illuminating power to the gas-jets which they were intended to displace, while the cost of operation was materially greater; and, no doubt for this reason, it was several years before much progress was made in applying it to this purpose. Perhaps the first pronounced success in this direction was attained in a plant erected in Vincennes, Ind., in the autumn of 1886. One hundred incandescent lamps of 30 c. p. were placed at as many street-intersections in the suburbs of the city, and connected by a single wire in a series 11 miles in length. The dynamo was of the alternating type, and the system as a whole was characterized by great simplicity and effectiveness. The only important objection arose from the circumstance that the occasional breakage of the filament in one lamp would instantly extinguish all the remaining lamps in the same circuit, a difficulty soon surmounted by the ingenuity of different inventors who occupied themselves with the problem. An inductive resistance is now placed bridge-wise across the terminals of each lamp, and, upon the rupture of the lamp filament, it comes into play to maintain the integrity of the circuit. In this manner as many as sixty lamps are now successfully operated in a single series. The cost of poles, lamps, wiring, and fixtures in this system is comparatively small; in some cases not more than $6 or $7 per lamp, complete.

The very moderate cost, not only of installation, but of operation and maintenance, of the series incandescent system, will in all probability ultimately lead to its general adoption for public lighting in all except, possibly, the largest cities and towns. Under the conditions which are met with in most localities, experience indicates that the lamps should not be less than 20, and need not be more than 32, c. p. to combine economy and good distribution of light. In most cases a 25-candle lamp, if run at its full rated voltage, will be found to give excellent results. A plain, neat type of fixture often used, which is perhaps as good as any, is made of ¾-in. gas-pipe, curved into a goose-neck and screwed into a cast-iron socket upon the supporting pole. The lamp is set into a protecting sheet-metal hood and fitted with an annular convex reflector. Such lights ought to be located at

intervals of from 250 to 300 ft., which in the central district of the town may with advantage be reduced to 125 ft. Along suburban roads lights 350 to 400 ft. apart will often serve the purpose sufficiently well. A fair contract price for supplying and operating 25-candle lamps in this manner for street-lighting would be from 1¼ to 1½ cents per hour, or say $20 to $24 per annum, when burned until midnight. Where cheap water-power is available, such lights have in some few instances been supplied by contract to municipalities at a rate as low as $16 per annum, but this could only be done at a profit under exceptionally favorable circumstances.

One very important advantage attending the use of the incandescent lamp for public lighting is that, with reasonably good management at the central station, it may be depended upon to give its full rated quota of light at all times and under all conditions of weather. Unlike the arc-light, it is affected by neither rain, snow, sleet, or wind. A 25-candle lamp will give in practice from twice to three times as much effective light as the average gas-lamp formerly found in the public streets of our cities and towns. Another advantage is that a one-wire line may be extended through the territory to be served in the most convenient way, and its terminals connected at any required points to the opposite feeders of any of the alternating systems now in general use. Such a line may be erected in a handsome village street in a manner so inconspicuous as to be quite unobjectionable from an æsthetic point of view. Slender, neat poles of wood or iron, painted to match the trunks of the trees, and carrying one or at most two lines of thin black-coated wire, may, by the exercise of reasonable care, be rendered so unobstrusive as to be scarcely apparent to the casual observer.

From the considerations which have been presented, it is apparent that the choice of a system of public lighting best adapted to the requirements of any particular municipality depends upon the conditions of the case. While it is probable that in the majority of instances the most uniform and evenly-distributed out-of-door illumination may be obtained by the series incandescent system, when judiciously laid out and installed, yet it cannot be denied that in places where it is desired to have the streets present a gay and brilliant appearance nothing can be more striking and effective than a liberal provision of standard arc-lamps, placed at a moderate elevation above the ground. Nevertheless, the humble kerosene lamp may in skilful hands be made to produce results which suffer but little in comparison with those derived from more pretentious sources.

# ECONOMY IN RAILWAY OPERATION.*

(SECOND PAPER.)

*By L. F. Loree.*

WE have always poked more or less fun at our English cousins because of the difficulties they experience in handling the three classes into which they divide their passengers. Lardner said that in 1848 the third-class passengers constituted 42 per cent. of the total on the L. & N. W. In 1868 the companies began attaching third-class carriages to some important trains, and in 1872 to all trains. This was accompanied by a rapid increase in third-class travel, partly at the expense of the two other classes, so that in 1888 it constituted 80 per cent. of the business and is now estimated by Mr. Prout to be nearer 90 per cent. In 1875 the Midland reduced their difficulties by abolishing the second class.

The fact is that we in this country struggle with the same difficulties by giving our passengers special accommodation in sleeping, chair, and other special cars. These are used by not more than 10 per cent. of the passengers, and constitute a considerable item of expense,—one that will bear careful study. Much can also be done in decreasing car mileage.

Train mileage should be increased only after careful investigation of its necessity. It is probable that the business, as a whole, is not a source of profit to American lines. This condition is painfully aggravated by glaring evils, to which attention is constantly being called. Van Oss sums them up as free passes, rate-cutting, maintenance of the scalping system, superfluous agents, and injudicious advertising, and says that a large system should save $300,000 annually on its agents' roll, and that $16,000,000 annually might be saved to the roads of the country by abolishing the scalping offices.

The expenses incident to the handling of the trains constitute nearly one-half of the expense of operating the road, and, as Wellington has very well pointed out, until all has been done that can be done to reduce the number of trains required, it is hardly worth while to give a thought to reducing the expenses per train mile.

As the freight business constitutes approximately two-thirds of the total business and earns practically all the profits, it is naturally that which occupies the chief attention. The experience of my own divis-

*In the preceding paper under this title, on page 10 of the April number of this magazine, a table was given, entitled, "Average Miles per Locomotive per Month." The caption should have been "*per year*" instead of "*per month*"—a typographical mistake so obvious that it would probably mislead no one, but I prefer to thus definitely correct it. L. F. L.

ion is typical of the enormous reduction in the number of trains required to move the traffic, in consequence of the increase in locomotive and car capacity. In 1886 we began replacing our light 17″ × 24″ cylinder engines with heavy engines of the consolidation type, 20″ × 24″ cylinder. At the same time the cars were converted from a capacity of 15 and 20 tons to 25 and 30. The result was that, while the ton mileage of 1892 showed an increase of 75 per cent. over that of 1885, the increase in car mileage was only 16 per cent., and there was an actual decrease in the freight-engine mileage of .02 per cent. There is still a good deal of train mileage moved in this country with light engines. The last word has not been said in the matter of increasing the capacity of engines or cars, and we are likely in the future to reap substantial results from a further exploration of this field. I have heretofore expressed the opinion that much of the advantage gained through the heavier engine will be duplicated in reduced grades, and at practically the same cost.

Of vast importance, also, is the volume of traffic. Wellington points out that "12,000 to 14,000 miles of trunk lines make nearly one-half the earnings and carry far more than one-half the traffic of the country; the remaining 115,000 miles manage to live on the rest of it." It is upon additional tonnage that railroads grow rich. And few things have so potent an effect in reducing the expense per unit of traffic as additional tonnage, very few of the items of expense of operating being necessarily affected by it. At the present time, however, —and this is a necessity of panic times,—attention must be confined largely to the small economies of reducing the expenses per train mile. Let us despise not the day of small things, nor sneer at our efforts as "catch-penny methods" or "the small economies of the German method," for these have resulted in no inconsiderable saving. I think we may lay it down as a fundamental rule that *there must be no lost or repeated movements, but each movement must count economically by advancing the traffic in the direction in which it is earning money.* The heart of the transportation business is the station work. Upon the efficiency of those who do it depends the success of the subsequent movements. The clerical work should be carried on simultaneously with the handling of the goods, the side cards being attached to the car and the way-bills completed by the time the car is ready for its journey. Care should be taken to convey the goods direct from the wagon and weigh-scale to their place in the car; to stow the goods so as to avoid damage by breakage; to load the goods, if in a way-car, with reference to their removal; and to load the car as nearly as possible to its capacity. Not only does this last help to secure the minimum train mileage, but it effects further economy from the fact that such increase

in the load does not proportionately increase the work done by the engine. There are few fields more fruitful of economic results than the loading and movement of cars. A keen eye should be kept on the cars belonging to foreign roads, in which nearly 40 per cent. of the business is handled. Unless the car has 3,000 lbs. of freight, it probably will not pay the mileage charges. Just as in the days of "wild-cat" banks the issue was taken to distant points to be put into circulation, so in times of light business some roads that cannot keep their cars profitably employed send them to distant points with insignificant loads in order that they may earn mileage. At the car accountants' convention of 1894 this knavery was fully canvassed, one road reporting as a sample a car from Vermont to a point in the far west, sealed and in bond to cross through Canada, containing one tub of butter. This led to the practice of carefully examining all foreign cars and passing them through a transfer-home for the consolidation of loads. In one day the contents of sixty-four cars were reloaded into fourteen cars. Besides the saving in train service, the avoidance of payment of mileage was a considerable economy. About $44,000,000 changes hands annually in settlement of mileage accounts, and this practically without check, each company being absolutely dependent upon the honesty of the other's returns. Each year at the car accountants' convention disclosures are made of "short mileage." It is hardly possible that so disgraceful a condition can long continue, and we find the car accountants following the recommendation of the English commission of 1867 by asking for the "charging for the car by time instead of by distance," thus making it possible for each road to demand an accounting for each of its cars for the 365 days of the year. This, however, is but a small part of the advantages of the change. With such a system the using road will no longer find it profitable to hold the cars of other lines idle for weeks, acting as agents in the solicitation of freight or as warehouses for the accommodation of shippers. Against the abuse of their equipment by the public, the roads have in a measure protected themselves by the collection of demurrage through car-service associations, and it hardly seems possible that they will long delay defending themselves against similar abuse by their competitors. Mr. Wheatley concludes that under the present system a car stands still four days for each day that it moves, and makes the low average mileage of 24.7 miles per day, a decrease of 22 per cent. between 1883 and 1892. Under improved conditions it is entirely practicable to increase this movement to 40 miles per day, enabling the traffic to be handled in 813,626 cars, saving $124,000,000 in the investment in equipment and $10,000,000 annually in maintenance. The cars, on being made up in trains, should be arranged in the order

of the stations to which they are destined, the time wasted in switching on the road being very great. The engine should be loaded to its capacity. The method usually adopted is to rate the engine as capable of hauling so many cars, five empties being considered the equivalent of three loads. With the wide variations of weight of lading, this method on most lines does not secure the desired result. A method greatly advocated of late is to load the engine on a tonnage basis. The capacity of the engine on a level grade being ascertained by dynamometer test, its capacity on the ruling gradient is calculated. The light weight of the cars is taken from the stenciled markings on the car, and the weight of contents from data placed on the way-bills. These are then added together to determine the weight of the train, and cars added or cut off as necessary. The defect of this method is that it does not give consideration to the resistance offered by the car independent of its load. Nor do I find anywhere a determination of this resistance that is at once satisfactory and simple of application.

Munhall figures that in the merchant marine 20 per cent. of the sailings are in ballast. About one-third of the car mileage is made by empty cars. Every effort should be made to reduce this empty mileage, and, where cars run uniformly light in one direction, back lading should be actively canvassed for. A fruitful source of trouble is the fact that, while the traffic moves during the 24 hours of the day on most roads, the directing force, except the train dispatchers, work from 8 to 16 hours only. The office that distributes cars and power and controls the make-up of trains should never be closed. In discussions before the car accountants' association, it has been suggested that no car be moved without certainty as to its destination; that a daily inventory be taken of the cars on the line at some stated hour; that there be a comprehensive system of carding at terminal points; that the cars, whose numbers now run absurdly and awkwardly high, be renumbered, using prefix letters for the various classes of equipment and numbering from 1 up for each class; and that the joint inspection bureaus now coming into vogue be organized at all points of considerable interchange. In moving trains over the road, many duplicate movements may be avoided by a proper arrangement of sidings at stations, and by the adoption of "lap-sidings" at passing points.

Switching mileage (shunting) affects locomotive economy quite as unfavorably as empty mileage does car movement. It appears to furnish work for 28 per cent. of the engines in New York State and for 70 per cent. of the engines on the Lancashire and Yorkshire Railway. It is frequently possible to substitute gravity switching, which is much

less destructive of equipment and quicker and more universal of application, and costs nothing to generate. Where possible, this should always be used. The cost can also be much reduced by building separate tracks for the switching movement, so that it may not be delayed or stopped by the road movement.

The expenses incident to injuries to passengers and freight do not exceed 1 per cent. of the total cost of operating. The loss on account of injuries to goods, which is about as $1.70 to $1.00 on account of injuries to passengers, has never attracted much public attention, though it is a source of intense irritation to shippers because of the delays with which most companies settle these accounts. This is aggravated by the fact that the really large sum thus expended is distributed in a great number of very small amounts. The claims of less than $30 constitute over 90 per cent. in number and about 33 per cent. in amount. But the matter of injuries to passengers is a cloud that, no larger than a man's hand at first, has come to cover the whole heavens. While the direct expense to the companies is small, the indirect expense, from installation of expensive appliances, increase in force, reduction in the capacity of the plant to handle business, and the increase in capital account, has been enormous. In almost every other item we have made rapid, and are now making slow, but continuous, reductions, but in this we seem to have discovered a field for the mushroom growth of increases. The safety of our operations are constantly and unfavorably compared with those of the English, and the community, press, and legislatures bring strong and constant pressure to make our practice duplicate theirs. Prout concludes that in the last 6 years the roads in the United States killed about four and a half times as many passengers as those in England relative to their train mileage. Jeans says that in that country in 1883 eleven people lost their lives by accidents to trains, rolling stock, etc.,—causes beyond their own control. Operating under our conditions, the inference is that fifty passengers would have been killed. They have, therefore, by their improved practice, saved the lives of thirty-nine passengers each year; but at what cost? The most important difference in practice is that the English work their traffic by the block system. Jeans estimates the cost of the installation of this system up to 1883 (the work began about 1872) as $43,000,000, or an addition of 1 per cent. to the capital account, and the wages of the additional men required or working the block signals and stations, together with the cost of maintenance, stores, interest on cost of plant, etc., as $11,250,000 per annum. That is, the English people are spending eleven and a quarter millions annually in this one item to save the lives of thirty-nine people, or $288,470 for each. Let us reflect that in the same year 293 people lost their lives

on English railroads through trespassing,—lives that might have been saved by a proper exercise of the police power and without the cost of an additional dollar. Does not the result seem a trifle ridiculous when "compared to the massive battalions daily sacrificed in the conflict which mankind seems forever doomed to wage against intemperance, bad sewage, and worse ventilation." But, if the matter must be considered as one of high importance, it may well be inquired, in view of the experience of Massachusetts, New York, and Ohio, whether nearly as good results cannot be obtained at a fraction of the cost.

Personal injuries are usually divided into four classes. On a line of considerable importance, where the statistics are carefully kept, they bear the following proportions:

| Class. | Percentage in number. | Percentage in amount paid in settlements. |
|---|---|---|
| Passengers | 6.7 | 22.92 |
| Travelers on highway | 5.3 | 24.08 |
| Employees | 75.9 | 46.62 |
| Trespassers | 12.1 | 4.38 |

While the ratio of trespassers injured seems small, the injuries are usually fatal and represent about one-half of all the deaths. The disproportionately large number of injuries to employees is largely due to not separating the accidents happening to the men engaged in train movement from those happening to the men engaged in construction and repairs. Injuries to carpenters in falling from the roofs of houses are not uncommon; because a man happens to be on a railroad's maintenance-of-way rolls and is injured while repairing the roof of a station, it would hardly seem reasonable to classify it as a railroad accident. Mr. Barr finds that 32.6 per cent. of injuries to employees are due to hand brakes and link and pin couplers,—many being caused by the personal neglect of employees arising from familiarity with the dangers attaching to their occupation. The fact that Mr. L. S. Coffin, who perhaps has been as active as anyone in calling public attention to this source of danger, found it advisable at an early stage of his work to organize a Railroad Temperance Association, "the white button of which 100,000 practical railroad men put on in one short year from its inception," may indicate another prolific source of trouble. The more one studies this question, the more one is inclined to agree with the opinion expressed by With as long ago as 1852: "The number of these accidents depends upon the character of the employees; the seat of the evil is to be found here. I do not hesitate to repeat it even to weariness."

An analysis of train accidents which I have made with some care on my own division shows them to have been due to the following causes:

| | Per cent. |
|---|---|
| Defect of road | 16.22 |
| Defect of equipment | 20.94 |
| Negligence in operating | 50.68 |
| Unforeseen obstruction | 1.35 |
| Malicious obstruction | 0.67 |
| Unexplained | 10.14 |

One-half of the accidents appear to be directly attributable to negligence on the part of those engaged in the train movement. If we attribute also to negligence one-half of those accidents classed as defect of road and equipment and as unexplained,—as I think is not unjust,—then three-quarters of the train accidents flow from this cause.

The Miller Platform and Coupler began to come into use in 1863. The former has been much improved, and quite recently has received the further development of the Pullman Vestibule and Communication and Safety End Device. The latter, with the invention of Janney, has come to conventional lines under the moulding influence of the Master Car Builders' Association. The Westinghouse Continuous Brake, invented in 1869, is now in almost universal use on passenger equipment. The three have operated powerfully in reducing accidents to passenger trains. Under an act of congress the roads are required to replace automatic couplers and continuous brakes on their freight equipment by January 1, 1898. This entails an expenditure conservatively estimated at $40,000,000. The Inter-State Commerce Commission gives the following table of progress in this work:

| | | |
|---|---|---|
| | June 3, 1889 | 80,510 |
| | " 3, 1890 | 115,319 |
| | " 3, 1891 | 169,035 |
| | " 3, 1892 | 244,334 |
| | " 3, 1893 | 322,238 |
| Unequipped | " 3, 1893 | 986,496 |

In handling so large a body of men as that employed in the railroad business great care must be taken in their selection, training, and organization. The force is probably under-officered, and is lamentably weak in the matter of inspectors. As was claimed in a recent report, "the army, which represents the acme of discipline, has, for a regiment of 1000 men, some 35 commissioned officers, and the officers are to look after 1000 men who are close together, virtually at all times under their eyes; while upon the railroad the same number of men would be controlled by certainly not more than 6 what we may call commissioned officers, yet the 1000 men on the railroad are scattered over 100 miles of territory, greatly increasing the difficulty of handling them," and their work is distributed over the entire 24 hours of every day. The salaries paid the officers are not sufficient to retain them permanently in the service, the younger men being con-

stantly drawn away by street railways, large manufacturing plants, mining companies, etc. Unfortunately the rewards are too few, the promotions too slow, to excite the best efforts of the thousands employed. How much greater, then, the obligation to distribute them with justice,—an obligation too often ignored!

As to the men, I know of but three ways by which to improve them: (1) to get rid of such as are vicious, incompetent, or incapable of improvement; (2) in employing new men, to raise the average in character, education, and fitness; (3) to educate and train to a high degree of proficiency such as are retained in the service.

Generally the discipline is chargeable with favoritism, uncertainty, delays, too great severity or too frequent condonings, the reasons for which are not apparent on their face. Nowhere is the question of discipline so simple. The individual is brought into contact with too many persons to make it practicable for him to conceal the essential facts, and in the case of accidents the written history, the wreckage itself, tells the story to the trained eye. In fact, where the discipline is guided by a firm hand and one in which the men have confidence, the whole story is usually told by the men at fault with a straightforwardness which cannot be too highly praised.

But in this force, healthy and right-minded as a whole, is usually a small number of malcontents, vicious and irreclaimable. They ought to be vigorously hunted out and uprooted. But without much hunting the boiling-pot throws them to the surface. Then it should be remembered, as has been well said, that the exercise of virtue is often more dangerous than vice itself, because it is without the restraint of conscience. Probably in no other fields can greater evils grow so quickly from the drowning of justice by mercy.

No man should be employed unless he give references covering the five years immediately preceding his employment. A large part of the labor troubles of recent years have been caused by a class of men who tramp from one end of the country to the other,—"stake-men" who stay on one road only long enough to run up board bills which they do not pay, disappearing after a "pay-day drunk." For the troubles growing out of the continued employment of this class the railroads have only themselves to blame. Every man employed should be examined by a competent surgeon as to his physical fitness. The State now requires that men having to do with signals be examined as to their sight and hearing. There are many other defects, affecting safety or economy in operating, that should bar a man from the service. It would be a distinct gain to the country if the railroad force could be brought to as high a degree of physical perfection as the United States army has attained.

The tendency of late years has been not to take on employees under twenty-one. This seems to me an error; as an economical measure nothing can exceed the introduction of a reasonable number of young men of sixteen or seventeen as station employees, shop apprentices, telegraph operators, yard employees, and firemen. They are quick, industrious, easily moulded. Most of the men now controlling the details of operation started at that age. The country cannot afford to let "organized labor" degrade its youth by idleness or postpone their employment so late in life that their habits have become fixed, rendering them no longer teachable. The railroads at best have not the training faculty highly developed, and can ill afford unnecessary handicaps. In this, as in the employment of women, we can learn a useful lesson from the English lines. Of the 55,217 employees on the London & North Western only 130 are girls in the accounting department. "The railroad business," says Sir George Findlay, the general manager of that line, "is preëminently one requiring for its efficient conduct a high degree of smartness, alacrity, energy, and zeal on the part of every individual engaged in it." Nowhere, perhaps, can the dictum of Napoleon, "Let her attend to the distaff," be urged with greater force.

Besides the preliminary examination, the men should be examined periodically, with a view to instructing them in their duties, to terminating the engagements of such as are without promise, and to giving the better men some chance of overcoming the "rule of seniority" which is a prime cause of the lack of interest on the part of some of the men. Care should be taken to place the men in that division of the service to which they are best suited, and to keep in mind the necessity for personal contact with them to secure the best results. While the majority of men want to do their duty, their range of vision, from the nature of the business, is so narrow that they are unable to efficiently perform the work assigned to them unless very closely looked after by some one with a broader view and more liberal education.

There are certain forces outside the railway corporations which exercise more or less influence over them,—for instance, the labor unions. These organizations, copying closely the theories and methods of their English prototypes, are, if they may be judged from their written constitutions, of noble aim and high purpose, and exert influences of great good on their members, the railroads, and the community. Unfortunately, they have developed all the worst faults of the political "machine," and have fallen under the control of small cliques of active intriguers As Baker has pointed out, "We are now confronted by the fact that the wage-workers in the various trades of the country are engaged in exactly the same monopolistic schemes, and have ex-

actly the same ends in view, as the monopolists who combine millions of dollars' worth of capital to effect their purpose. . . . . The monopoly formed by trades unions in the sale of labor is unnatural, because the number of competing units is great instead of small. As new competitors must continually arise, the monopoly can never be successful without the use of unlawful means." He shows from the census of 1880 that there are 14,744,821 persons engaged in occupations not monopolized to 5,647,368 engaged in occupations more or less monopolized, and concludes that trades unions do not exert any lasting influence on wages.

Buckle asserts that "to maintain order, to prevent the strong from oppressing the weak, and to adopt certain precautions respecting the public health, are the only services which any government can render to the interest of civilization." Fortunately governments in this country have displayed little disposition to interfere in the operations of railroads, and then usually only to correct some flagrant abuse. Beyond this they have "marred" rather than "made." In Ohio, for example, one legislature decreed that the height between the station platform and the lowest steps of the car should not exceed twelve inches. This may be a convenience to a few persons of excessive avoirdupois, but it entailed on the railroads of the State an expense of $75,000; led to the abolition of many flag stops where people had before been content to scramble up off the ballast, and who felt much convenienced thereby; and has been the means of preventing the establishment of new stops on the score of expense.

The railroad problems are formidable, and require time and much labor in their working out. They are not to be solved at a session of the legislature, and efforts at such solution of the questions of grade crossings, steam heat, block signalling, etc., are likely to prove a costly experience to the roads and the community.

# A MARVEL OF MECHANICAL ACHIEVEMENT.

*By Robert Perkins.*

THE bicycle marks at this moment the utmost advance of inventive thought, and its construction crowns the highest pinnacle of mechanical achievement.

The foot of the panther, the wing of the eagle, and the rolling sphere,—these are the superlative models combined by the final art of man in a structure which, for lightness and strength, for carrying load and avoiding shock, is almost worthy to rank even with the creations of Nature herself.

The noiseless tread of the feline foot, the large thin tube and the edgewise strain-resistance of the aquiline wing, and the nearest known approach to that motion without change of the centre-of-gravity plane which belongs to the sphere rolling on a straight line,—these are the elements combined in the design of this matchless machine, whose construction employs to-day perhaps a hundred millions of capital in this country, and the finest and most ingenious machinery which American talent can create.

First a toy and then a whim, and then that least regretted of all departed things,—a toy and a whim dropped, discarded, and forgotten, —the bicycle had the living force of a vital seed dropped in the fertile soil of man's eager desire, and has risen from the dead not only to be the instrument of one of our grand divisions of out-door sport, but to enter seriously into the business and daily life and pleasures of civilized man in every division of the globe.

It is a strange story, this of the velocipede which died only to spring up again as the bicycle, into an all-pervading life after resurrection.

As a passing craze among those Athenians of America who seek every day some new thing, it crossed the ocean to England, and, when it had become so dead here that the very name was disgrace, and costly wheels could not be even given away, but were abandoned by their owners because of the odium which horse-owners had succeeded in bringing upon the velocipede, English muscle was rejoicing in a new field of wide-range exercise; and so, after ten years of mouldering in the tomb of popular disapproval in America, during which the velocipede constantly grew in favor abroad, rechristened as the bicycle, the winged wheel crossed the ocean once more, this time to the westward, and the reign of the bicycle began in America with the "high" or "Ordinary" wheel. The high wheel had a well-made, comparatively

light steel tubular frame, wire-spoke suspension wheels, and solid narrow rubber tires, which glided into public favor and large use so silently and quickly as to become a universal out-door presence while yet the non-using public was hardly aware of its return from improving travel abroad.

Lallement, the roving Frenchman, brought some parts of his crank-driven wheel with him when he crossed the ocean to the United States in the sixties. A blacksmith by trade and a genius by gift of God, Lallement had conceived the simple and impossible idea that a man supported on an unstable basis of two unfixed points could exercise the utmost power of the largest muscles of the human body without loss of balance, and believed that, by applying those muscles to turn a wheel of much larger radius than the crank on which the foot acted, a man could thereby increase the length of his stride, and so greatly enhance the rapidity of human translation from one place to another.

Genius is always right; it would not be genius else; and it is astonishing, when we look back along the line of successful march of an accepted invention, to note how exactly right in particular and detail the inspired madman was in his first conception of the new thing.

Lallement used two wheels of the same size, as shown in the illustration of his original machine which was photographed for use herewith, and equal wheels of 30, 36, 38, and 40 in. diameter, with wooden hubs and spokes and rims and steel tires, were the first constructions. The wire-spoke suspension wheel was known, and some elegant examples of all steel wheels were to be found among the velocipedes of 1869–70, which was about the date of the greatest first popularity of that horseman-maddening structure.

This low wheel brought the rider very near the ground, far lower than the occupant of our American carriage sits, and hence not only exposed him to the dust of horse-drawn vehicles, but made it an easy matter for him to be run down by enraged horse-drivers, or cut by a whip in the hands of some insulted owner of a trotter, annoyed at the ability of the despised rider of the despised machine to keep abreast of him, despite the best clip of his speedy roadster. This was the real reason of the hatred of the horse-driver for the old velocipede-rider. The horseman invariably lost his temper when the velocipede kept even with him or ran away from him, and soon open war was declared. Horsemen rode the velocipede down without scruple when able to catch the nimble usurpers of highway privileges with a shadow of excuse for the assault; speedy, skilful velocipede-riders ran persistently in front of magnificent turnouts, in a way to drive the horse-owners to distraction, and wilfully frightened timid horses by flashing across the roadway in front of the animal's blinders. The horsemen had the wealth

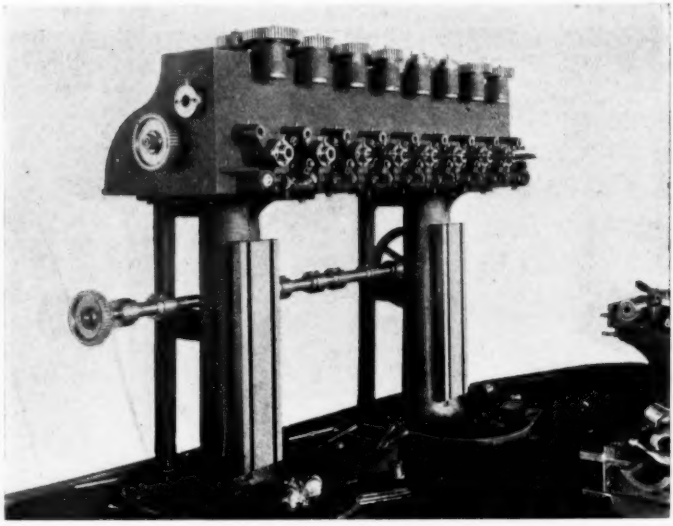
and influence and were able to control legislation, and soon had the velocipede ruled off the park drives and sidewalks, leaving them only the streets and the footpaths of the parks. The rigid tire made riding on a rough paved street simply torture, and on a dusty suburban road—the only place left the despised velocipede where the rider could find pleasure—the velocipede carried the rider so near the earth that he was invariably a low, begrimed object, ridiculed by the carriage-riders and reduced in his own estimation by that sense of inferiority which belongs to low position and the consciousness of a begrimed face and dust-blackened linen. To avoid this low placing of the velocipede-rider, two western builders in '69 or '70 built large numbers of high or "Ordinary" wheels. Where the high wheel came from is not precisely known. There was a general tendency to make the rear wheel smaller than the front crank-driven wheel; Pickering, if memory serves correctly, made his wheels, in the old days, of about equal size, while the Demorest had a smaller rear wheel. There appeared in one of the west-side Chicago parks in '69 a high style of machine, with all-steel wire-spoke wheels, 60 in. in front and about 15 in. or 18 in. rear. This was among the first wheels of these proportions. It was built, owned, and ridden by a young machinist from Cleveland, whose name is unknown. Just at the close of the velocipede period of favor, Merrill Bros. of Beloit, Wis., and Crane Bros. of Chicago simultaneously decided that the velocipede had come to stay, and each firm made large numbers of wretchedly-constructed machines, with frames of gas pipe and malleable fittings, wooden wheels and steel-tired rims. The Merrill was a high wheel in form. The Crane was between the Pickering and high wheel, with a rear wheel about half the front-wheel diameter. These machines would not hold together on the road for any length of time. The tapering threads where the pipes entered the fittings soon worked loose, the wheels gave out, and the whole thing went to ruin with amazing promptness. Long before Merrill or Crane sold out their stocks of wheels, the bottom dropped out of the sport, causing great loss to these builders, who had many hundreds, perhaps some thousands each, of these miserable machines left on their hands, to be finally sold to boys or whoever would buy at any price at all,—$15, $10, $5, or whatever was offered. This brought the velocipede into the hands of the very poorest boys and youths, and thoroughly killed the sport in the west, where it had great vogue for a while. The machines of Pickering and Demorest were well finished; the wheels were good; the frames were fine examples of smith work, made of light tubes welded together; and the finished machine was handsomely painted and silver- or nickel-plated, and cost from $75 or $80 for the cheapest up to $200 or $300 for the fancy finished vehicles. These

prices kept the velocipede out of the hands of the poor at first,—except mechanics skilful enough to build good wheels for themselves,—and hence there was for a time some distinction in owning and riding a velocipede.

Rinks were established in all the principal towns of the north, and had a great patronage. The velocipede was a comparatively heavy and strong machine with an endurance up to really rough riding, and the regular rink floor equipment included inclined planes, flights of stairs, and jumps of various heights, and fancy rink-riding involved such work as would wreck the present bicycle in the first round. Trick riders and professionals came to the front, and were very expert, although at that time the now ordinary feat of riding the unicycle was debated as an improbable achievement. The future of the velocipede was in doubt, though the chances seemed in favor of its permanent popularity. Then came the determined and concerted action of the horsemen, followed quickly by municipal regulations which restricted the area of velocipede use to wholly undesirable localities, and the tide of public sentiment turned so that the solitary velocipede-rider was pretty sure to meet unpleasant events every time he took a spin on a public road ; and presently the whole art was in disgrace, and the velocipede was dropped—forever as it seemed—in the United States.

In England the conditions were quite different. The English highway is a smooth, dry, hard, well-cared-for surface, perfectly adapted to the use of the cycle. Beside the public roads, there are picturesque pathways winding past purling stream and violet bank and hawthorn bloom, all open to the narrow tread of the silent steed ; this matter of perfect roads and lovely bye-ways gave the bicycle-rider in England a vast range, freeing him from the necessity of intruding on the side walks or terrifying the nursemaids in the public parks. Another element of success for the bicycle in England lay in social distinctions, which are there so clearly defined that the patrician or horse-owning class did not deign to notice the goings-on of the mechanic in his outings. There were clashes, of course, between the wheel men and the horse men, but they were individual affairs, never rising to the dignity of class differences, and did not disturb the triumphantly victorious march of the cycle from its first position of an interesting novelty to that of a prime desirability for purposes of both sport and business. The cycle can test muscular endurance, and English muscular endurance loves to put itself under trial ; this national trait of love for athletic sport, and the national habit of good road-making, insured the prompt adoption of the bicycle by that vast class of English youth which could not aspire to the cost of horses, but yet had fifteen or twenty pounds and plenty of time to spare.

GENERAL MACHINE ROOM—ALL SMALL PARTS, HUBS, SPOKES, CONES, ETC.



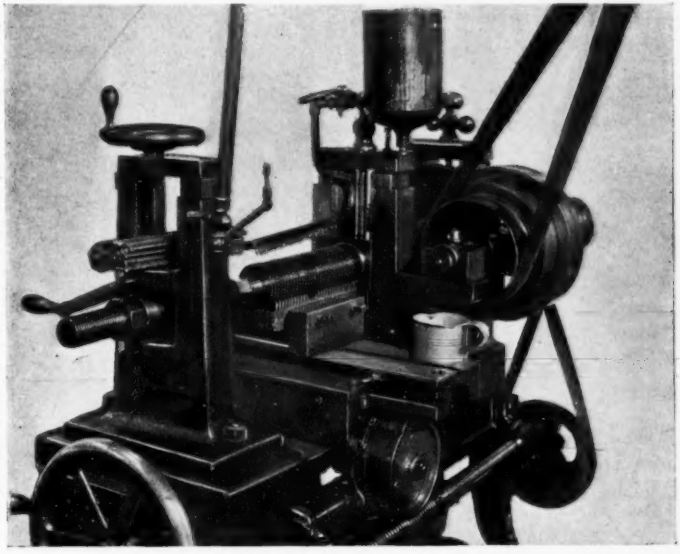
MASSIVE TOOLS IN CONSTRUCTION AT OUR FOREMOST SHOPS.

I first saw a bicycle in 1869 at Wood's establishment, Edgeware road, London. I bought one in 1870 of Driver Bros., Crescent road, Plumstead, London,—an Excelsior. It had a pair of 36-in. wheels; weight, 116 lbs. I put rubber tires on this machine in 1871; I had never seen a rubber tire on any machine, and hence can claim to be one of the original inventors of the soft tire. These tires were made of half round solid rubber cemented on the felloes. The tire was vulcanized together at the ends. I next built a machine in 1871 from lines of my own; weight, 75 lbs. This machine was borrowed for racing purposes, because of its lightness. It had a 38 in. front wheel and 12-in. rear wheel, with solid backbone and forks. I did some racing on this machine, with a personal record at the Bat and Ball Cricket Grounds, Gravesend, Kent, of 4.02.

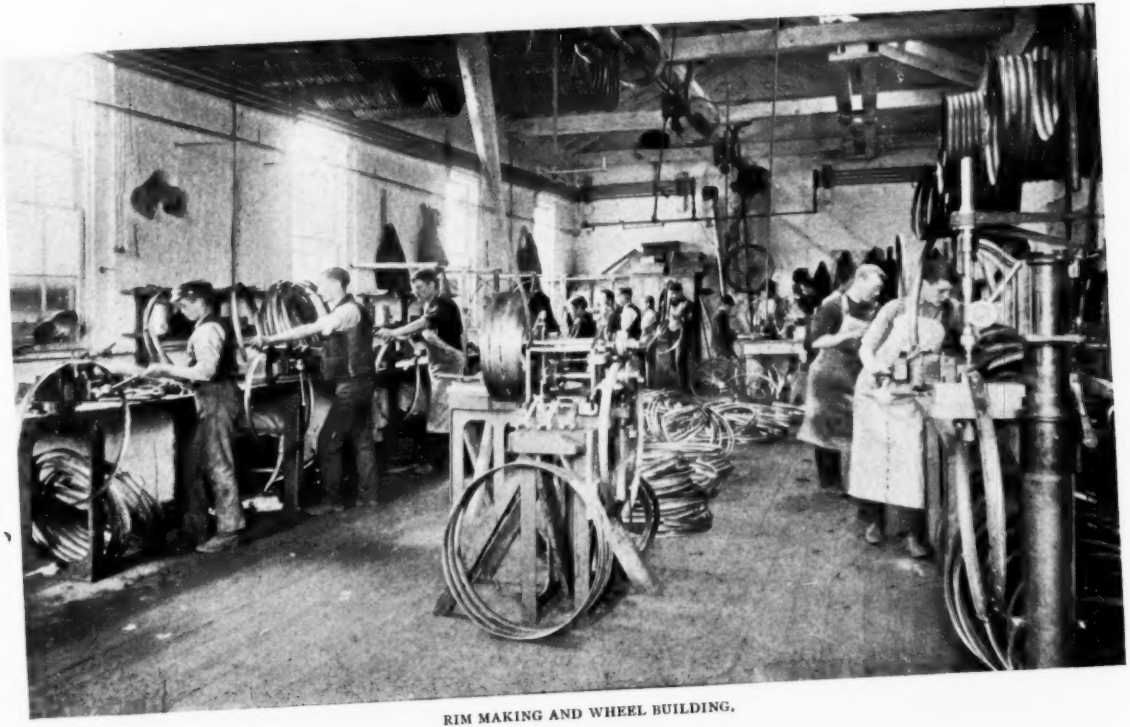
The high or Ordinary front wheel was first put out in 1871 by Markaham, Edgeware road, London. About the same time Hyam of Wolverhampton, now in Washington, D. C., acting as agent for Humber, brought the first Ordinary to America. Hyam, who was a very expert trick rider,—the cleverest of his day,—introduced the high wheel in the United States with great approval. I saw the first unicycle in 1874, ridden by David Stanton, at Agricultural Hall, Islington, rider inside. Dan Canary, the most notable American trick rider, perhaps, who ever

appeared in England, did veritable unicycle riding at the Crystal Palace, London, in 1886. At the last cycle show the Black Manufacturing Company exhibited in January, 1895, a machine weighing only 8¾ lbs. This machine was exhibited in January, 1895, and was called a freak by its makers. It was, however, a rideable machine, and would carry a 160-lb. or 180-lb. man on a floor. The lightest Ordinary I ever saw, 54″×16″, was exhibited by Harry James, of Birmingham, England, at the Stanley Bicycle club show in London, in January and February, 1890. This was a substantial machine, and was ridden on the floor day after day, although its total weight was only 11¼ lbs. Of cycles made at the present day, the lightest are racing machines. Extreme lightness leads to a great many repairs, and 24 or 25 lbs. is light enough for common use. My first regular connection with the manufacture of bicycles was in August, 1875, when I made a few machines on my own account,—"Ordinary" style solid rubber tire, of various sizes, 52″×16″ medium.

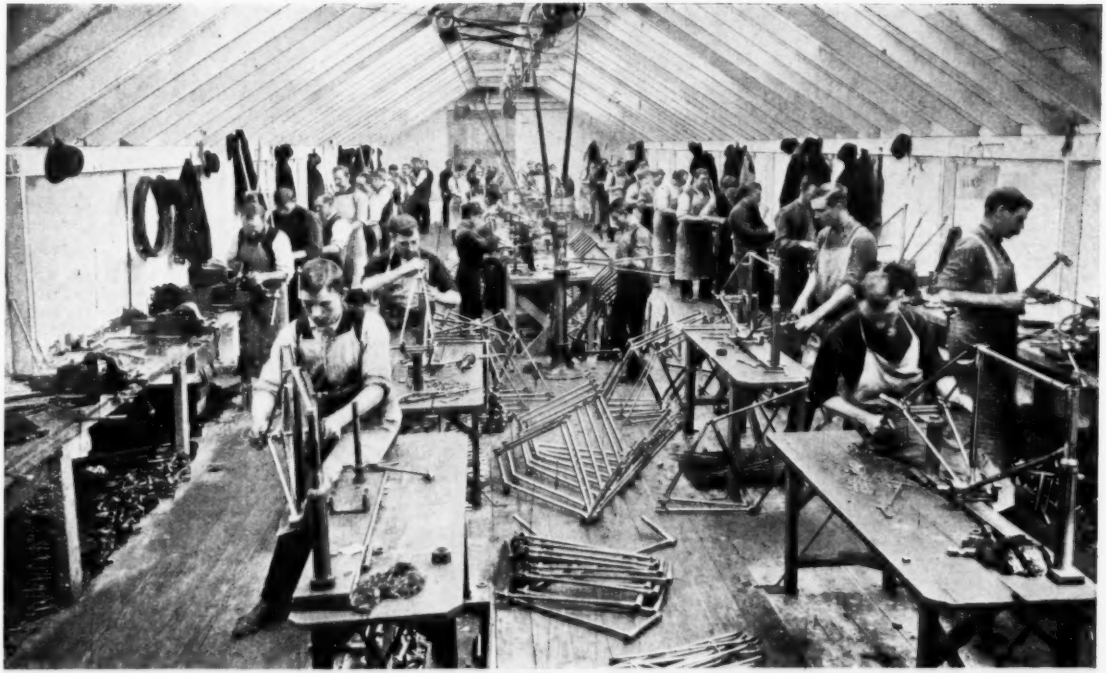
All the wheels up to this date and for some time after had steel rims. I first saw the pneumatic tire in 1889 at Booth's bicycle agency, Dublin. This tire was invented and patented by Dr John B. Dunlop, and was received with abundant ridicule as an absurd impossibility, but



THE MILLING MACHINE GNAWS STEEL WITH ITS MYRIAD TEETH.



RIM MAKING AND WHEEL BUILDING.

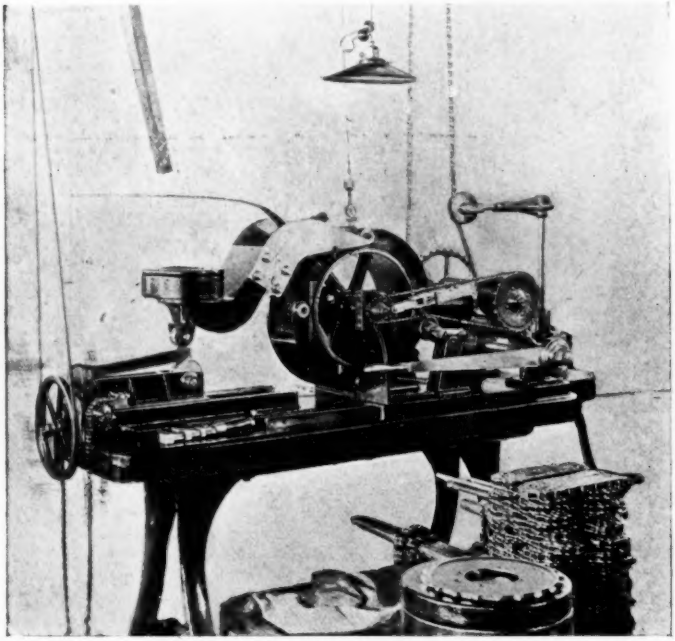


FRAME ROOM. BUILDING AND SETTING FRAMES AND FRONT FORKS.

it had faithful followers and a steady growth, which it constantly maintained until it reached its present exclusive use. Dr. Dunlop patented the pneumatic tire in England and America ; the patent was not broadly for a pneumatic tire, but covered details which have since gone out of use. Dunlop's inventions have, however, kept pace with the state of the art, and he at present conducts large manufactories for pneumatic tires both in England and the United States.

The liability of the rider of the Ordinary to take unpleasant headers was very early recognized by all bicycle users, and the Star, which was a reversed Ordinary, having the small wheel in front, was devised, and had considerable use at one time.

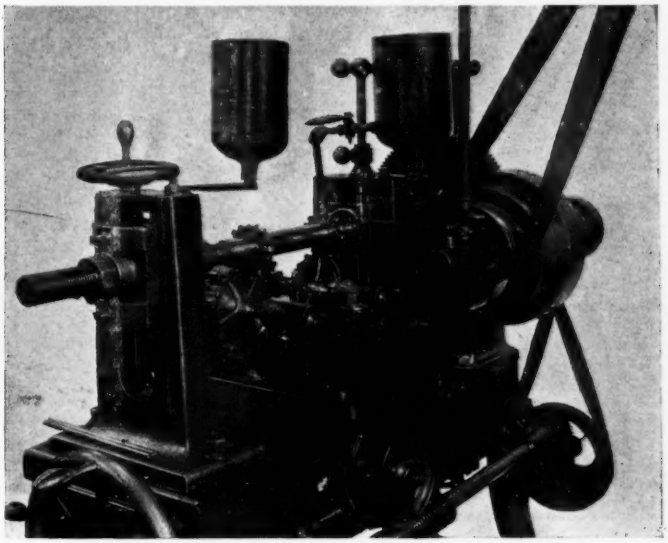
No really satisfactory solution of the problem of the header could, however, possibly be had with the high wheel. The rider sat high ; a tumble was always possible ; and the great distance of the rider from the ground often made the fall serious. To meet the situation, Mr. D. K. Sharley, of the firm of Sharley Bros., Coventry, England, designed the Kangaroo, which was an Ordinary cut down to wheels of 30 and



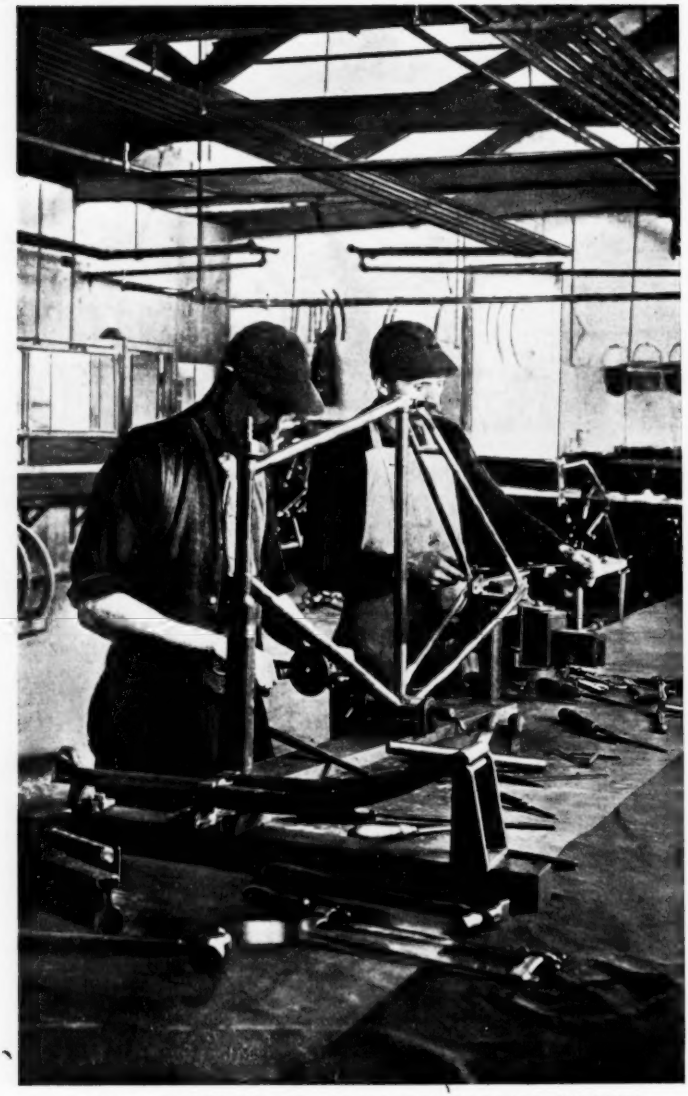
PRONY BRAKE CHAIN TESTING MACHINE.

NICKEL AND COPPER PLATING PLANT.

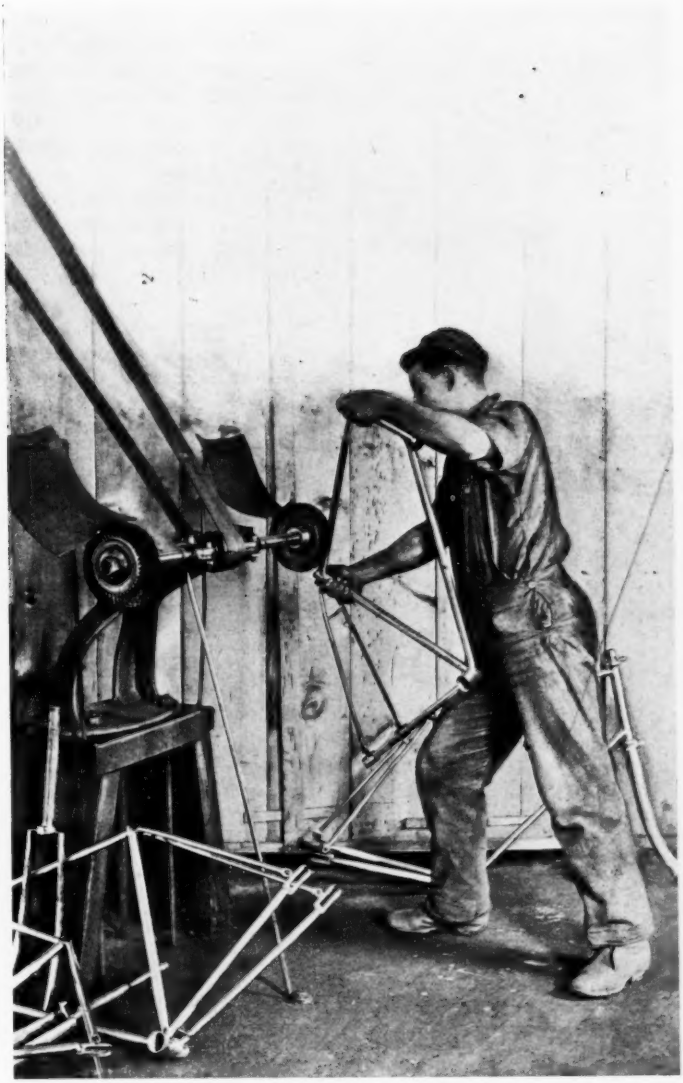
16 in. The Kangaroo had a diamond frame, independent crank shafts and was geared by two chains to the front wheel. It will thus be seen that the Kangaroo had features which have not, so far, been superseded, and which form the basis of our present practice. The



SHAPING THE RIMS OF THE CHAIN SPROCKET WHEELS.



CUNNINGLY DEVISED GIGS ARE USED FOR ASSEMBLING THE FRAME PARTS.



THE EXPERT POLISHER HOLDS THE FULL DIAMOND FRAME TO THE WHEEL.

A CORNER IN THE FORGE SHOP.

first Safety, named the Rover, was brought out by Sharley Bros. This wheel retained the independent crank shaft and introduced diamond frame, but was driven by a single chain from the crank shaft to the rear wheel, both the wheels being 30 in. in diameter. The weights of the Rover and Kangaroo were about the same, and both machines were very fast for the time and made new records. The Kangaroo had a considerable sale, but soon gave way to the Rover, which was the faster of the two, and gave the present Coventry cycle industry, which now employs about 15,000 hands in 40 workshops, its first decided impulse.

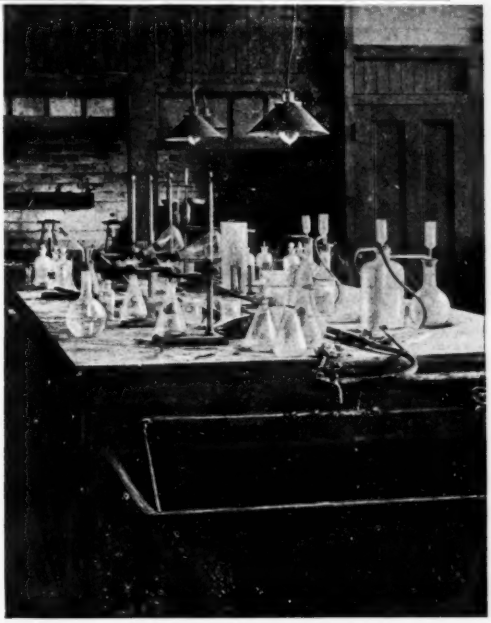
The first Safety, a Rover, was brought to America by Mr. L. Owens, now dealing in cycles at Washington, and was taken up very promptly by American makers, the firm of Smith Bros. of Washington being first in the field with the Dart Safety on the lines of the Rover. Thus both the Ordinary and the Safety found first root in America at Washington, which has, however, never had a very large bicycle factory.

With the advent of the Safety, which came very nearly back to the Lallement diameters with its equal wheels, the possibility of the universal use of the cycle may be said to have fairly begun. The pneumatic tire, diamond frame of light steel tubes, ball bearing, and chain and sprocket wheel multiplying gear, were combined in the Safety, which lacked only the wooden wheel rim to contain all the elements of our present machines. Like all other finally-adopted details of con-

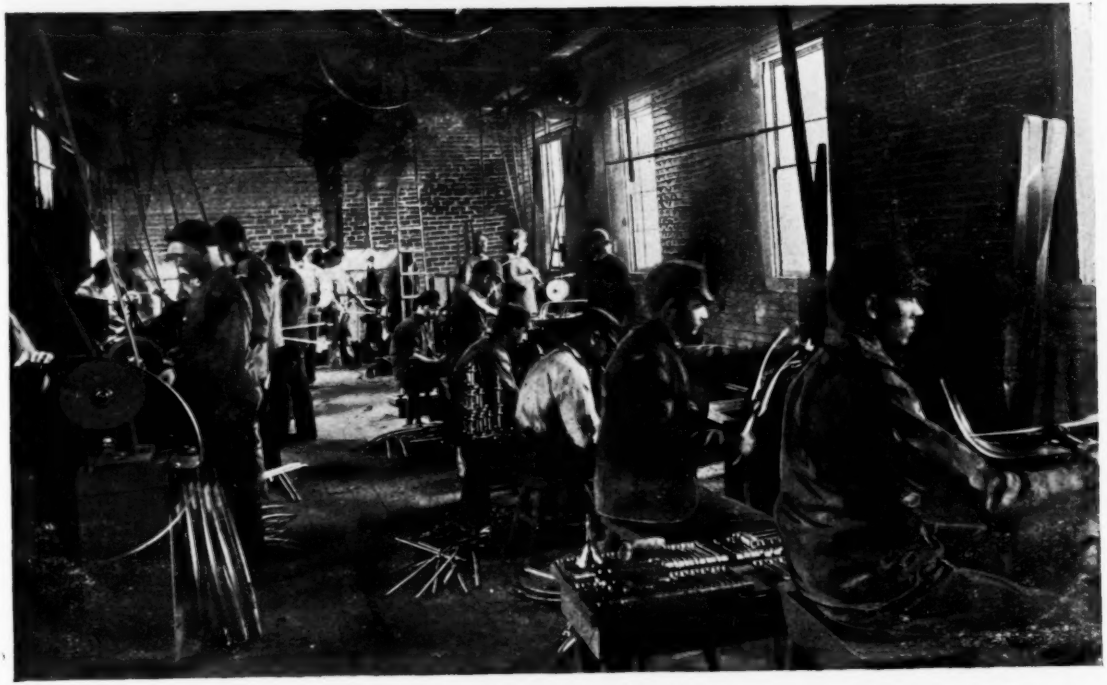
struction, the wood rim met with great opposition. The steel rim had a tendency to "buckle," which is not present in the wood rim, and the wood rim is also much the stronger of the two, weight for weight, so that the wood-rim cycle is about 2 or 2¼ lbs. lighter than the steel wheel-rim machine.

The pneumatic tire is the greatest single improvement applied to the cycle. It was shown by the establishment of new records to be faster than anything else from the first; but its true theory was not generally understood, and it was not at first a fully recognized fact that, the more easily the tire yields, the faster it is. With a rigid tire, if the wheel meets an obstruction say ¼" high, the wheel must lift that ¼" bodily to surmount the obstacle; but, if the obstacle has a small surface, the pneumatic-tired wheel need not lift appreciably to pass over it; the obstacle sinks into the soft tire, and the wheel passes at the same level of motion it would have were the obstacle not present. The pneumatic tire thus saves a constant large rise and-fall action of the cycle, and the softer the tire is, the less the rise for a given obstacle.

But before the present return in the safety form to Lallement's original wheel dimensions, the Ordinary or high machine had great vogue in the United States, commencing about 1880-81. It is largely probable that the old Lallement, Demorest, or Pickering form could never have come into use again in America. But the Ordinary carried its rider's head proudly above the common herd,—well above that of the carriage-rider, even; the enormous front wheel not only lifted the

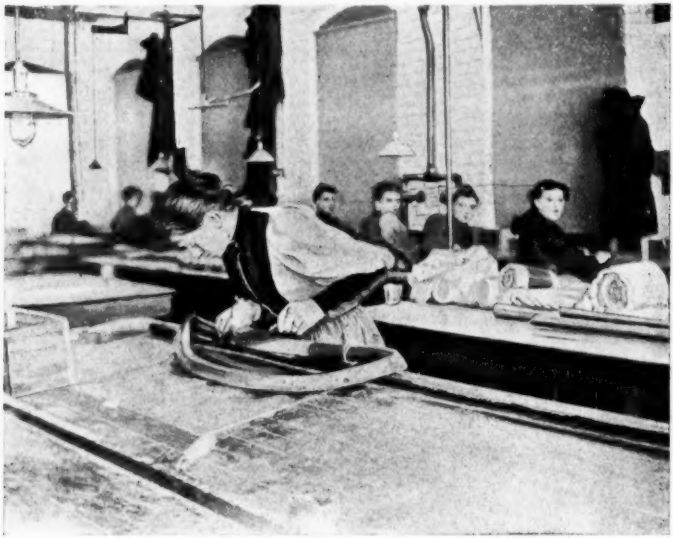


DELICATE CHEMICAL TESTS OF MATERIAL ARE MADE.



POLISHING, BUFFING AND GRINDING.

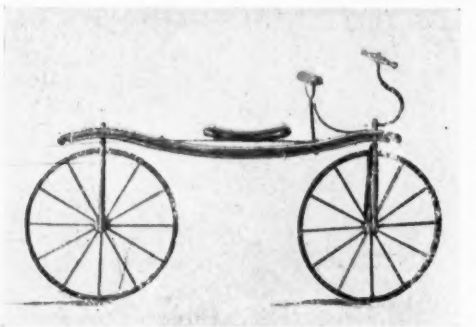
ASSEMBLING ROOM—ASSEMBLING FINISHED PARTS.



DEFT FINGERED GIRLS MANIPULATE PNEUMATIC TIRES.

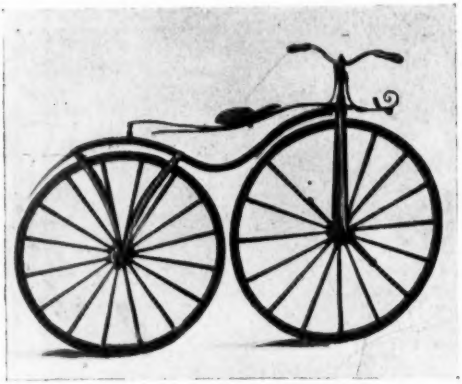
rider out of the dirt, but gave him, at reasonably rapid travels, a slow and dignified muscular action which increased rather than lessened his self-respect, and brought the wheel into constantly increasing favor among American youth.

But while it is probable that the velocipede could never have been received under the new name of the bicycle without the use of the large wheel it is at the same time certain that the severe falls, the weight necessary to give usable strenght to the large wheel, and the general unhandiness of the ordinary style of machine made it impossible that the type should endure; hence, as soon as the mission of the high machine had been accomplished by reinstating the



THE FIRST, PROPELLED BY THE RIDER'S FOOT ON THE GROUND.

FOUR MEN CAN STAND ON THE SIDE OF THIS COBWEB WHEEL.



THE FIRST MACHINE EVER MADE WITH CRANKS.

bicycle in popular favor, its inherent faults at once drove the public back to the use of the small two equal wheels, geared to give the stride by making more than one revolution to one double stroke of the foot. Having brought the machine into favor with athletes and young men of outing tendencies, the high or Ordinary wheel was promptly displaced by the old Lallement form, which made its universal use possible.

From about 1881 or 1882 the revival of the cycle in the United States progressed with wonderful rapidity, and has never suffered any check. The hard times did not seem to affect the purchasers of bicycles, and the output for this season of 1895 is estimated at four hundred thousand, or about double that of any previous year for the United States. The importation of cycles is decreasing, and the exportation increasing. The American cycle is more largely machine-made than the European article, owing to the higher prices of American labor, and the well-known American aptness in devising special tools has been very largely exercised in applying wonderfully effective variations of the screw machine, milling machine, and drilling machine to the

THE HIGH COLUMBIA ON WHICH STEVENS RODE ROUND THE WORLD.

production of cycle parts. Appliances for brazing have also been largely developed and improved, and, in fact, every process employed in the production of the cycle has been brought to a point of wonderful excellence and low cost.

But the real miracle is the machine itself,—especially the wonderful strength and resistance of the wheels. It would seem absolutely impossible that a wheel 30 in. in diameter, with a wood rim and wire spokes so light that the whole structure weighs only 20 ounces, should sustain without permanent distortion the weight of four men standing on its side, with supports at four points only under the rim, and no hub support whatever, as shown in the illustration.

It also seems incredible that a cycle capable of carrying a man of 160 or 175 lbs. in weight can be made so light that the whole structure weighs less than 9 lbs. Yet this has been done; even at the roadster weight of 22 or 24 lbs., the cycle carries a greater load with safety than has ever been put on any other vehicle.

The influence of the cycle on social life is already great, and will probably constantly extend, as it provides an out-door sport and amusement for women which did not previously exist in any form in America. American women are not walkers, but the cycle is perhaps even better suited to woman's use than man's, and seems destined to add an out-door element to the life of woman the world over which was not possible without the "winged wheel."

Our American cycle factories are now equipped with the finest plant which can be constructed, and are fully equal to the best armories, — or even superior, as they are the later construction; and the magnitude of the operations and vast numbers of workmen employed warrant any expenditure which promises to cheapen the production or improve the product. But all this was inevitable. Granted the cycle and its great use, the vast cycle factories with their magnificent equipments, marvels of ingenious tool-making, and wonderful methods of construction, were certain to follow.

The miracle of the bicycle lies in its birth, death, and resurrection; in its incredible load-bearing power in proportion to weight; in its displacement of the horse as a means of pleasure; and in the selection of its mechanical details of compressed-air support, tubular framing, and chain driving. All of these are details often before introduced in machines, but never before permanently retained. That these cast-offs are undeniable power-savers is convincingly proved by their continued use under human muscle-driving power.

Finally, the one great achievement of the bicycle is to increase the human powers of locomotion so that the slow-footed man is made one of the swiftest of all running creatures.

# THE NEW SCIENCE OF ELECTRIC HEATING.

*By W. S Hadaway, Jr.*

HEAT is so closely allied to an adequate shelter in warming, and to food in cooking, that we must regard it from the practical standpoint of a prime necessity, and, in treating of its generation and distribution, base our deductions largely on whether the owner of a particular form of heating apparatus can operate it economically, and whether the user, or party to whom the heat energy is furnished, can employ it as cheaply as other forms of heat supply, with reasonable regard for collateral advantages. A heating system, to be an advance on existing methods, must be a source of wealth to the owner and a source of economy to the user.

A system of heat and electrical generation and transmission derives its value, largely, from the benefits of concentrated control, like other systems of public works. We are to regard heat agents as commodities which can be economically generated, transmitted, and applied. Electricity as a heat agent is not to be regarded as a source of heat, as that expression is generally understood, but, technically, as the high-potential heat factor in a telethermal system, where the heat secured is generated by simple resistance; or, we may employ electricity as an agent for producing available heat in operating a thermal engine by means of motors.

Of the fuel consumed under good steam boilers at least 65 per cent. of the heat energy is available for useful work. Steam in the best of steam engines theoretically possible can only transform 25 per cent. of the boiler energy into active mechanical work, and in practice 12½ per cent. is not generally exceeded. The engine work can be very economically transformed into electrical energy, in which form, considering it as heat, transmission losses are relatively small. In good steam and electrical practice the heat engineer can secure about 10 per cent. of the fuel energy in electricity, and of the balance of the fuel energy may write off 35 per cent. as direct loss and 55 per cent. as indirect loss. The indirect loss can be utilized with a properly arranged system of steam distribution over limited distances; and the combination of the electrical energy, available for heating purposes at varying temperatures, but usually above 212° F., and the exhaust steam, available for heating purposes at temperatures below 212° F., the writer has termed a multi-potential thermal system, in which electricity is employed as the high-potential heat factor and exhaust steam as the low-potential heat factor, and in which the heat energy is available for use in a tele-

thermal system. That is, in practice, we have a system in which the ratio of high-potential heat to low-potential heat is about one to five, figured from thermal units and not temperatures, and in which the total fuel efficiency is about 50 per cent.

In domestic and industrial work we find two broad classes of heat control. The first class includes operations requiring diffused heat on a large scale, as in room and water heating, or heat of low potential and large quantity. The second class includes processes where heat is used at high temperatures and in small volume, as in cooking and laundry work and in many industrial operations, or heat of high potential and small quantity. A reasonable estimate of the relative thermal units employed in each class is found, after careful investigation, to be about five to one, assuming as a line of temperature demarcation 212° F. The average temperature differences between the two classes are not in the same ratio as the quantities, with this unit, but are sufficiently great to warrant a distinction between prices for heat energy at low potentials and at high potentials. What this difference in price should be can only be conjectured, but a fair rate of charge would seem to be not far from four or five times as much for high-potential heat as low-potential heat.

A practical illustration of the multi-potential heat system may be found in the requirements of a modern apartment-house in which there are several families, each with a kitchen and small laundry under the tenants' control, and with electric lights, steam heat, and hot-water supply, from a common source. The house equipment would consist of boilers, engines, dynamos, &c. The incandescent lamps, ovens, grills, flat-irons, &c., would be heated by electricity. The rooms and the water for bathing and culinary purposes would be heated mostly by exhaust steam. The owner would derive practically two profits from the fuel burned,—a direct revenue from heat supplied for cooking and laundry work, and an indirect revenue from utilizing the secondary products of the first.

In present practice the owner equips the house with gas ranges, which are a source of direct revenue, not to himself, but to the gas company. Electric lights, hot water, and steam heat are furnished by the owner, and figured as part of the rental value. The lights load is of so brief duration that the hot water and steam heat must come from live steam for a considerable part of the day. With a somewhat larger engine and dynamo, on the plan outlined, the live steam used would be largely supplanted by exhaust steam, on account of the larger load factor, besides providing a direct revenue to the owner to pay for fuel, labor, &c. The cost to the user of the electrical energy for cooking and laundry work at 4 cents per h. p. h. is not greater than gas at

$1.00 per thousand, provided all water-heating is omitted and the electrical apparatus fairly well controlled. The user or tenant secures a great number of collateral advantages, which represent the same advantages for less money or more advantages for the same money, and the owner may convert an expense into a revenue.

The illustration brings "electric heating" within our definition of an advance in heating systems, and shows a sufficient reason why the subject should receive the respectful attention of capitalists, property owners, and their architects. It also shows that the expression "electric heating" is an unfortunate one, as the problem is one for the heat engineer, in which steam and electrical engineering are elements, and in which the electricity used is the thermal equivalent of only about one-sixth the heat energy distributed and applied.

There is, to the writer's knowledge, no installation extant completely illustrating the multi-potential system of heating. The Yaryan installation of central-station hot-water heating at Toledo, O., described in *Heating and Ventilation* (Feb. 15, 1895), closely approaches it, and lacks only the application of electricity for cooking and laundering in the houses heated; and this installation is especially noteworthy in using water for thermal storage and circulation in connection with the exhaust steam-heat storage. In the *Electrical Engineer* (April 5, 1893) will be found a description of the Springfield (Ill.) Electric Light and Steam Distribution Plant. This installation approaches the hypothetical illustration closely enough to remove all reasonable doubt as to the strict accuracy of the deductions made for the multi-potential system.

In developing electric central stations the desirability of a large load factor is apparent. With full knowledge of the requirements in various cases, data on electric cooking and heating have been patiently and carefully collaborated. The result entirely confirms theoretical deductions as to the extent to which the station can provide at a profit the energy for cooking and heating. There is no doubt that the central station can furnish at a profit the high-potential factor in the thermal system. The question now rests as to whether the customer or householder will find a divided heat supply desirable. Of the six parts used, the electric central station can provide one-sixth, the high-temperature part, the customer himself burning coal, or gas, to furnish five-sixths of the heat. The electric central station can operate electrically-heated chafing-dishes, and pots for five-o'clock-teas (replacing the alcohol lamp); curling irons; plate-warmer in the pantry; laundry irons; small water-heater for nursery; bath, and dressing-room warmer, &c., and these specialties can all be made to increase revenue without adding materially to the construction account.

At a 5-cent rate per h. p. h. the devices enumerated are perfectly practicable; and other specialties, like shaving-mugs, toddy-heaters, egg-boilers, hot plates, &c., are coming into use. These are all of value as a source of revenue to the electric central station and of convenience to the users, but it must be doubted whether, with so small a percentage of residence lighting as is now connected, and with the inability to offer but a partial heat supply when connected, electric heating apparatus, in which the heat is derived from simple resistance, will entirely provide the balance in the load sought for.

To illustrate the capacity of an electric station as a heat-producer we may compare the prices charged by the New York Steam Co. and the Edison Electric Illuminating Co. of New York, both operating in the same district and supplying steam and electricity respectively. Using the figures given by Dr. C. E. Emery as the basis of charges for the Steam Co., we find that it furnishes heat to large consumers at 40 cents per 1000 kals, the kal being the equivalent of 1110 thermal units. For 40 cents 1,110,000 heat-units are supplied. Taking the Edison Co.'s rates, and using the 50 per cent. discount as the rate to a large user, 40 cents will purchase 8 h. p. h., or 20,518 thermal units. The ratio between the two is nearly 54 to 1; or, as a loss must be figured in the case of steam, dependent upon the temperature at which the condensed water is allowed to escape, practically 50 to 1. It would be unjust to leave the figures on the mere heat-equivalent of the two forms of energy, as high-potential heat energy is almost universally secured by localizing a small proportion of fuel energy and allowing the rest to escape, and is consequently worth more per heat-unit; but, even were we to admit as a reasonable charge five times as much for high-potential heat as for low-potential heat, the ratio is still 10 to 1, and indicates what might be accomplished could the two plants be run conjointly for a multi-potential heat supply.

Lord Kelvin, in an article "On the Economy of the Heating or Cooling of Buildings by means of Currents of Air," published in the Glasgow Philosophical Proceedings, Vol. III, December, 1852, and followed by mathematical demonstrations in the *Cambridge and Dublin Mathematical Journal* for November, 1853, has made some most interesting deductions.

"In the mathematical investigation it is shown that, according to the general principles of the dynamic theory of heat, any substance may be heated 30° above the atmospheric temperature by means of a properly-contrived machine driven by an agent spending not more than about one-thirty-fifth of the energy of the heat thus communicated; and that a corresponding machine, or the same machine worked backwards, may be employed to produce cooling effects, requiring about

the same expenditure of energy in working it to cool the same substance through a similar range of temperature. When a body is heated by such means, about thirty-four thirty-fifths of the heat is drawn from surrounding objects and one-thirty-fifth is created by the action of the agent; and, when a body is cooled by the corresponding process, the whole heat abstracted from it, together with a quantity created by the agent, equal to about one-thirty-fifth of this amount, is given out to the surrounding objects."

In editing his "Mathematical and Physical Papers," Lord Kelvin added the following interesting note under date of June 26, 1881: "The method of cooling air in unlimited quantities described in this article has been realized by Mr. Coleman, first in refrigerators used for the distillation of paraffine, and, after that, in the Bell-Coleman refrigerator for carrying supplies of fresh meat from North America to Europe; in a great refrigerator recently sent out for the abattoir at Brisbane, Queensland, &c."

When Niagara is set to work for the benefit of North America through electric conductors, it will no doubt be largely employed for the warming of houses over a considerable part of Canada and the United States. But it is probable that it will also have applications, though less large, in other cold countries to multiply the heat of coal and other fuels, and to utilize wind and water powers (with the aid of accumulators) for warming houses.

The accomplishment of this form of heat control would enable us to construct uni-potential thermal systems, in whch the high-potential factor would be secured directly by the heat of resistance and the low-potential factor by employing electricity as agent to operate by a motor a device like that outlined by Lord Kelvin. A system of this sort would appear to largely increase the central-station load factor, and we would simultaneously introduce a large summer load by employing the same device, in reverse cycle, for cooling.

Of course many minor modifications of the two thermal systems outlined will suggest themselves. The gist of the whole matter is that for electric heating (or its synonym, central-station heating) to be economical a multi-potential thermal system must be operated, which is entirely feasible over moderate distances; or, assuming that electric central stations are to continue to run with the present deplorable fuel economy, the second or uni-potential system is the only feasible one, considering the whole subject in its broadest sense, and remembering that, while the device to accomplish the results sought is shown to be theoretically possible, it has not yet been entirely developed.

Where a complete thermal system is to be constructed, with coal or low-cost carbonaceous materials as fuel, the multi-potential combina-

tion is the direct way to secure high fuel economy and profit to the owner and user; and where only the mechanical equivalent of heat is available, as from motors, water-powers, gas engines, &c., we must interpolate a device for diffused heat control to heat buildings, and water for use in same, in addition to the energy for high-temperature work, which we can profitably secure from direct heat of electrical resistance.

Results already accomplished in electric heating depend wholly upon the high-potential factors of the broad systems outlined. The time is not ripe for a comprehensive review of the collateral benefits derived from a highly localized form of heat energy, our concepts of the elasticity of which are only measurable by concepts of the rigidity of the ether. Instead of a concerted effort to create a field of use for the apparatus by constructing complete thermal systems, nearly all of the applications have been made as minor incidents in systems of electric lighting and power already established. This, of course, is logical pioneer work, but it fails to reach the vital elements necessary for full development.

The famous "Electrical-Heater Man" at the Franklin Institute in 1884 was the butt of the practical jokers among his co-exhibitors. The apparatus there shown was the first form of the electric car-heater, with which to-day upwards of five thousand cars are equipped. The status of the electric car-heater is peculiar; it cannot be regarded as an economical device, but rather as a public requirement. An electric car is too small and crowded to admit of an economical and efficient isolated system of heating. Again, very little actual heat is required under average conditions, but rather a small amount of sensible warmth, uniformly distributed to each passenger on the basis of individual effectiveness. This can be met by an electrically-heated radiant at an energy consumption of less than 100 watts per sq. ft. of surface, and, in the common 20-ft. car 20 sq. ft. of radiating surface are sufficient for average conditions, and 35 sq. ft. of radiating surface for extreme conditions.

Too little regard has been paid to the item of individual effectiveness in rendering cars comfortable. So much energy has been wastefully used in air warming, even under average conditions, as to render the power consumption a most serious matter. The result is to give an unjust impression as to the cost of making cars habitable by electric heaters, and in the case of elevated roads, using large cars in trains, the item is a still more important one, as the energy for heating may equal or exceed that for propulsion. Again, in the case of elevated roads there seem no good reasons why the small rooms in the stations along the line should not be heated by the same agency as the cars, and

in economical work of this magnitude we appear to be forced back to the uni-potential system using electricity as agent.

In small cars the heat of resistance is not excessively expensive. As in the case of the Vaudeville Theatre installation in London, there are peculiar local conditions which, as practice has proven, can be satisfactorily met with resistance heaters. But, while under ordinary circumstances we can heat bath- and dressing rooms in residences by resistance heaters quite cheaply, considering intermittent use, we would not attempt to heat the whole house by the same means. If electric roads would locate their stations contiguous to business blocks and utilize their exhaust steam for heating purposes, there would be no difficulty in meeting the requirements of car- and station-heating on a large scale by resistance heaters. The *Railroad Gazette* (March 22) has given some interesting figures on "The Cost of Heating Cars by Electricity," in which comparisons are made between heating large cars by electricity and by steam. As a general rule, the smaller the divisions of space and the more intermittent the use, the greater is the economy of electric heating; and we may include in this rule water heating as well as space heating.

Cooking by electricity is an important part of electric heating. In practice it means the accomplishment of high-temperature processes by resistance heaters, using other sources of heat energy for the hot-water supply and, preferably, water-boiling processes, as in vegetable-cooking. One of the most complete analyses of this subject which has appeared was published in *Science* (Sept. 15, 1893). The deduction is made that electricity at about 11 cents per h. p. h. is as economical as the common coal-range for cooking, provided the electricity is used to heat an oven, the hot water being secured from outside sources. This appears to presuppose a radical change in cooking methods and apparatus, and, while this is undoubtedly proper in order to get best results, practice has seemed to require at the outset a more elastic system, in which the utensils conform to the generally accepted notions of what shapes and sizes should be.

To this end an experimental plant has been operated for 15 months in charge of a cook without special instructions as to the best method of operating the apparatus for economy, the desideratum being that good cooking shall be done and the utensil disconnected from the circuit when the cooking is completed. The equipment consisted of an oven, broiler, portable stoves, spider, plate-warmer, coffee-pot, and small tea-kettle. The result has shown that, with apparatus conforming generally to the accepted notions of cooking utensils, the cost of electric cooking is practically equal to that of the gas and coal stove as generally run, when electricity is supplied at 4 cents per h. p. h.

This does not show what can be accomplished under best control, but is a practical result in common usage.

The economy of electricity as a thermal agent in cooking is not doubtful, provided the uses to which the various forms of heat supply are put are proportioned in accordance with their heat-equivalents, limiting electricity to high-temperature work. In combination with steam, both live and exhaust, there appears to be no reason why hotels and public institutions, operating their own plants so as to secure a multi-potential system, should not employ electricity in cooking very extensively, solely for the purpose of economy; for electricity in a well-designed isolated plant costs much less than 4 cents per h. p. h., especially if we utilize the by-products of its generation in useful work, as would be the case in a complete thermal system. Ethical considerations in connection with electric cooking are of value after the economy and simplicity of the apparatus are established. Cleanliness, localization of heat at predetermined temperatures, and coolness of the kitchen are important factors in connection with the servant problem. The use of electric cooking apparatus in cooking-schools is important, as constant temperatures are easily produced over extended periods.

In industrial work the applications of electric heating are rapidly multiplying. Nearly every manufactory of size has its own electric plant, and can secure electricity at low cost. In operating sad-irons and tailors' gooses, small glue pots, soldering irons, pitch-heaters, &c., sufficient compensating advantages are found to offset increased prime costs, in case they occur, and the outlook for extended applications in the industrial field is favorable. The ability to minutely sub-divide the heat energy, or, in other words, the elasticity of the system, makes it of special importance for use in manufacturing work.

It is impossible, within the prescribed limits of this article, to give more than a passing glance at the different factors in electric heating. We may perhaps best sum up the various sides of the problem as follows:

1. In constructing a thermal system, we may employ electricity as the high-potential heat factor, by resistance heaters, or we may employ it as agent in operating motors to drive a suitable machine to secure diffused heat control.

2. In a multi-potential thermal system the useful heat available is practically five parts low-potential heat and one part high-potential heat. In domestic life the ratio of heat required is found to be practically five parts diffused heat and one part high-temperature heat. Over limited distances we may therefore economically operate multi-potential thermal systems using electricity as the high-potential factor.

3. Electric heating is synonymous with central-station heating,

presupposes the same generic elements, and requires for economy a complete thermal system, in which due regard is paid to proportioning the work done in accordance with the heat-equivalents of the factors employed, all of which must be in such form as to constitute elements of a telethermal system.

4. Where the mechanical equivalent of heat only is available, as from motors, water powers, gas engines, &c., we can economically employ electricity only for high-temperature work ; for diffused heating on a large scale we must employ it as agent.

5. By constructing complete thermal systems, in which steam and electrical engineering are factors, the heat engineer can make electric heating a source of wealth to the owner of the system and a source of economy to the user of the heat energy, and therefore secure an advance on existing heating systems.

# MINING REPORTS AND MINE SALTING.*

*By Walter McDermott.*

THERE is such a great variety of badness in mining reports that a little grouping of the cardinal sins will be useful. In speaking of mining reports generally, for the purpose of illustration, I intend to cover, not only those made by mining engineers, but all those used in business, and so fairly subject to criticism,—from that of the learned professor of other sciences who is dragged from the seclusion of his study and put underground to be made miserable with candle-grease, down to that of the practical miner, who, having beaten a drill for a certain number of years, is prepared to dogmatize also on facts, figures, theories, and conclusions.

Amongst the old friends we meet in numberless reports, and which seem to need a little protection against excessive wear and tear, the following will be considered: (1) the true fissure vein; (2) increasing width in depth; (3) increasing richness as depth is attained; (4) junction of veins; (5) ore in sight; (6) proximity to a rich mine; (7) failure from mismanagement. Now, Heaven forbid that I should be held as speaking disrespectfully of any one of these things, each estimable in itself. My remarks are pointed only against their indiscriminate use, and particularly against their public use as catch-penny phrases in a way to imply more than they actually mean.

There has been more joy over the term "true fissure vein" than over anything else in the history of mining. The investing public has become intoxicated with the exuberance of its descriptiveness. The practical miner has grasped its effectiveness, and the first ring of his pick on an outcrop satisfies him he has got the genuine article with tap roots in the antipodes. What is a true fissure vein? It is supposed to be a fissure in the country rock filled with veinstone, which may be expected to go down to a considerable depth. The veinstone itself sometimes carries pay ore. This does not seem much to base any elaborate calculations on; and not only is it insufficient, but experience all over the world has shown that some of the most valuable ore deposits are not found in fissure veins at all. Even as far as mere depth is concerned, it is by no means yet established that true fissure veins go any deeper into the earth's crust than bedded deposits, contact, or pipe veins; and it would be of no consequence if they did go deeper, since they cannot be followed. Properly used, the term "true fissure" is usefully descriptive, but, where used as an incantation to call up visions of wealth to unlimited depth, it needs suppressing.

* Abstract of a paper read before the British Institute of Mining Engineers.

It is naturally gratifying to the owner of a mine to see his vein increasing in width as he goes down. It also looks well as described in a report, and must naturally be mentioned when it occurs; but in some reports the implication arises that it is a vital point and to be calculated on as continuing. If a vein went on increasing in width, it would very soon attain enormous dimensions; and, if it outcropped in a country blessed with the law of the apex, its lucky owner would have a good claim to a very large proportion of the earth when he got down a few miles. It may pretty safely be assumed that the increase in width will not continue, and, when it stops, it is very likely to be succeeded by a corresponding decrease, so as to keep up the usual average of things. When, say, a 50-ft. shaft sunk on a vein shows an increase in thickness from 1 ft. at surface to 6 ft. at the bottom, there is nothing to show that, in continuing to sink, the vein may not gradually or rapidly pinch again to its size at surface, or even much less. If any calculations were justifiable at all in such a case, general experience would certainly lead one to expect such decrease. The only positive conclusion would be that the vein is irregular in width. It looks nicer and more definite to say simply, "the vein is steadily increasing in width as sunk on," than to state that "the width of vein is variable, running from 1 ft. to 6 ft., and therefore, until further opened in length and depth, its average cannot be safely calculated on." The one statement is as true as the other, but the effect of the two in reading is not the same.

There is a touching confidence in the belief of many practical miners that veins get richer as they go down. Experience and disappointment often fail to shake this comfortable belief. Most practical men are able to cite a great many more examples of rich mines becoming poorer with depth than the reverse. I remember being struck with the inconsistency and persistency of the belief in depth in various camps of the Rocky mountains. Up in the highest ranges, say 12,000 ft. above sea level, there are mines which need sinking on to prove their real value; and 7000 ft. below them in the foot hills are mines equally needing depth. Probably the thought at the bottom of this belief rests, like some of the attractiveness of the true fissure veins, in the old idea of a central seething mass of precious metals, and in the forcing up of a molten vein-filling. This faith in the saving grace of depth and of true fissure veins in the face of facts can be explained only by the definition of faith as given by the little girl—"believing what you know is not true." The hankering for depth has its justification, of course, in the necessity for sinking usually to get any developments, but, where access is obtainable to the foot of a mountain through which a vein runs, the same men who claim a special efficacy

for depth in other cases will point to the vast advantages of having the ground above one to be opened by adits. The facts of experience show that, when a vein is rich at the surface, a hope that it may continue is a more proper attitude than a belief that it will get richer in depth; and, when it is poor on surface, any change in sinking would be for the better.

Striking cases of enrichment of veins at their junctions occur; but, as many examples of junction without richness also exist, it does not do to attach too much importance to the results to be expected. In some reports the future junction of two veins is often itself assumed on insufficient data, and the consequences are calculated on with a certainty which is still less to be justified.

Under the head of "ore in sight" is included matter which is of the very greatest importance, and which requires the very best work of an engineer. The estimation of ore in sight in an opened mine often involves the consideration of so many points, and is so largely a matter of good judgment, that one may expect some discrepancy in the reports of different engineers. There is nothing in which such vast discrepancies do exist, in fact, as in regard to this. Two good engineers will vary in their estimate; and, when it comes to inexperienced men, or to so-called practical men who have no reverence for the written word, the term "ore in sight" becomes a theme for the exercise of the highest flights of imagination and the airing of a little rudimentary mathematics. In the common mining report we are all acquainted with, it is not unusual to see the length of the chain multiplied by a cheerfully assumed average width of vein, then by 500 or 1000 ft. for depth, and a tonnage deduced which reminds one of the figures used for astronomical purposes. Sometimes, to inspire extra confidence, the expert generously knocks off 25 or 50 per cent., and feels he has then done his duty, whatever happens. The character and ability of a man can sometimes be closely estimated from the way he figures up ore in sight after giving the dimensions bearing on it; and it often suffices to look at this calculation in order to determine a report to be, not only quite unreliable as to conclusions, but equally irresponsible as to data.

In connection with estimation of ore in sight, the system of sampling employed is worth mentioning here. In some reports the expert writes of taking samples "at random." When a man says he has picked some samples from a dump "at random," and they assay well, he implies that such ore is plentiful on the dump, and that he did not purposely select it from its appearance. What his statement actually means is that on an important matter he was willing to trust to luck as to whether he hit poor or rich ore, or whether he was getting just what had been previously placed for him to get. Luck is a very necessary

thing in mining, but it should not enter into sampling. If the sample is a random one, its value proves nothing. Some people seem to think this method of sampling is important evidence of an impartial mind, and that shutting the eyes is the best security against the frailty of human nature, which would otherwise lead a poor creature to pick out the richest looking ore he can find.

Another little weakness to be remarked in some reports is the willingness to make a liberal discount off the expert's own figures. The writer concludes, for instance, from his samples—perhaps taken at random—that a gold vein will average 2 ounces of gold to the ton, but, to be on the safe side, generously offers to take it at 1 ounce, and then with a light heart goes into calculations of profits by day, and month, and year. If a man knocks off 50 per cent. from his supposed reliable figures to be safe, it always occurs to me that the one who reads his report may feel tempted to lop off another equal percentage to be still safer.

There have been plenty of illustrations lately published in prospectuses of the great value the public places on a property which is near a well-known mine; yet everyone who knows anything of mining must be aware that mere proximity to a paying mine gives no assurance of similar success. Some of these reports are absolutely nothing but a statement that the claim examined is on the same reef as, or near to, another property which is popularly supposed to be exceedingly valuable, and that rich ore has been found on the claim.

In quartz mining it sometimes happens that a series of paying mines are found at intervals along a single vein. Occasionally the intervals between pay shoots are long, so that a good mine may be immediately surrounded by poor ores. In other districts one single good mine on a vein is all that is ever developed. The only actual advantage of the proximity of a good mine is the evidence it affords of there being payable ore in the district, or on a certain reef. Like other indications, it is of service only when used with discretion, but as an unqualified argument of the value of a neighboring claim it is most dangerous.

That bad management may spoil a good mine is so self-evident a proposition that no one will misunderstand a few remarks against the improper or thoughtless use of this excuse in a report as an explanation of previous failure in a poor mine. A well-known Californian mining man, when asked to take charge of a mine which had failed to pay—as it was explained—from mismanagement, answered that he did not want anything to do with a mine which would not stand bad management. This is a remark which contains much matter for reflection, and embodies the opinion of most practical men. In reports the statement is sometimes loosely made that milling results in the past cannot

be relied on, owing to primitive machinery or processes hitherto employed. This argument has often been advanced on Mexican mines by experts who have not had time to find out that native methods of working often give better results than the rapid working by the most modern machinery.

After all these remarks as to what mining reports ought not to be, it is perhaps permissible to say a few words on what they ought to be. A report need not be long-winded to justify the fee paid for it, but should be so full in actual description as to enable a reader experienced in mining to draw his own conclusion from the facts given, without having to trust entirely to the deductions of the writer. Where a fee is paid for a simple expression of opinion or specific advice, there is no need of a report, in the sense of the word as we are now considering it. The important details to be set forth clearly are those relating to position, and facility of access to the property; local conditions as to fuel, water, and timber supply; extent and form of openings; variations in thickness of deposit; character and value, and form of occurrence, of ore. It is important in giving a clear idea of the property that the distribution of the payable ore in the deposit should be described. It makes a great difference sometimes in the conclusions to be drawn whether the value consists in rich ore occurring in a barren vein mass, or in high-grade ore scattered through a low-grade deposit, or in a uniform value throughout the rock. On account of the necessity for this description it is not always sufficient to state that an average width of vein contains an average of so much value per ton, as this may be in the nature of a conclusion, not of a fact, and so may need to be justified by detailed facts of the report. The extent and character of dump piles at a worked mine often afford valuable confirmatory evidence as to the character and value of the property.

Geology and mineralogy should naturally be used with discretion, but only for purposes actually bearing on the description and conclusions to be drawn,—not for mere padding nor for the airing of theories better treated in a purely scientific paper. I have seen a report which started with the nebular hypothesis and traced the progress of the earth from its pulpy state right down through its various stages to oxidation of the outcrop of a particular vein in the year of grace in which the report was written. These details were so full that there was no room left for anything but a very brief treatment of the merely commercial question of the value of the mine.

Examinations naturally differ greatly in the nature of the calls they make on the expert. In a district with which he is well acquainted there are often certain simple facts which enable him rapidly and safely to arrive at his conclusions; in other cases it is often a matter of hard

and conscientious work, however clever or experienced the engineer may be, and any scamping of this work will imply unreliableness. An experienced man in making a report will have an open mind for possible new forms of ore occurrence, while refraining from prophecy about things not in sight. Events may work against the most careful and experienced man by unforeseen increases or decreases in value on opening new ground; but, as mine examination is an art and not an exact science, it is by average results that an engineer must be judged.

There are all degrees of "fixing a mine": from the legitimate showing of its best features by not taking out all the rich ore before offering for sale, or by various degrees of skulduggery, up to palpable salting of mines, dumps, and expert's samples. In the less illegitimate stages much can be done, and very frequently is done, in the way of a judicious stoping of faces in good ore, and by the observing of a discreet silence as to past weaknesses and irregularities of the ore deposits. In such cases it is simply the ordinary commercial position of "let the buyer beware," and the expert has to show by his report if he has experience, observation, and sense enough to form a sound judgment as to value.

In a mine which is thus carefully prepared for selling, it is not at all uncommon for the owner to go beyond the legitimate limit already indicated, and to misrepresent facts by filling up or concealing old workings which would, if examined, produce an unfavorable impression. The next step in the downward path which leads to a hotter place (but in the meantime also sometimes to affluence) is the scooping-out of the inside of apparently solid blocks of good ground by openings afterwards filled up or timbered over. Some of the most experienced mining men and engineers have fallen victims to this and the previously described course of conduct; while some have just escaped being caught by a mere accidental indication of the fraud, or by "peaching" of some miner who helped in the work and had not been squared. Naturally the danger from the sources mentioned is much less in new mines of limited extent than in old mines extensively developed. In a mine which has been worked for some time the visiting engineer is at a great disadvantage as compared with the men who have worked in it for years, and perhaps devoted their greatest skill to making, not only a good record, but to concealing the exhaustion which is approaching. It happens occasionally also that the owners complete their work by "picking the eyes out of the mine" in the interval between the expert's report and the turning over of the property to the purchasers. The richer the nature of the pay ore in the mine, the greater the danger from this rascality, which needs specially providing against in the terms of purchase, and by other precautions.

The above-mentioned very real and not uncommon dangers, against which the engineer has to guard, are not, however, "salting" in its proper and technical sense, which is generally understood as covering any interference with the expert's chance of arriving at a true estimate of the value of ore. The salting may be done on the ore before the expert's arrival, or during his sampling, or on his samples when taken, or while panning or assaying.

Although cases are well known of faces in a mine being salted with such success as to catch the unwary, this form of salting is usually too difficult to carry out, and too superficial in character to offer much chance of catching an old bird. With ore dumps and alluvial deposits it can be done with better chances of success, but is naturally of an expensive nature if carried out on a really systematic plan. Cases are on record of successful salting of alluvial ground with precious stones as well as with gold, and the expert must clearly be on the watch against this, when circumstances allow of the possibility of its occurrence With ore dumps it is often very easy to arrange a veneering of good ore over a very large pile of poor or barren rock, and then, when the ingenious gentleman who takes samples "at random" comes along, he will be sure to obtain a gratifying result.

The salting of samples is, however, much more common than any other form of getting ahead of the expert. It is less expensive than salting in advance, more deadly, and can be nicely adjusted to circumstances and to the individual weakness of the victim. When the owner of the mine, or anyone connected with him, is allowed to assist in the sampling itself, there is no lack of opportunity with some ores for the artistic salting while in the mine; but, as a rule, engineers do not have the requisite faith in human nature to accept such assistance, unless the character of the ore and kind of samples required make salting impossible at the time. In a strange district, where assistance of some sort has to be obtained in breaking and transporting large samples, and the character of such assistance is not absolutely certain, the engineer must guard himself by duplicating entirely alone certain test samples. Assuming that samples have been secured without any chance of outside interference, the business is by no means ended, for the enterprising salter will follow those samples until actually panned or assayed, or taken out of his reach.

To the successful cultivation of the art of salting no great knowledge or experience of mining is necessary, any more than a study of architecture is essential to the practice of burglary. True ability will assert itself in this as in other employments by the invention of new means to meet special cases, and by a proper discretion in regulating the dose of salt administered to the temperament of the patient.

Sometimes the honest miner will freely relate stories of methods by which experts had been salted, implying delicately that no such schemes would be successful with his hearer, but reserving one, undescribed, for purposes of personal illustration later.

The microscope or a very strong glass is often of great service. In silver ores the silver-bearing minerals can often be washed out and identified; and with gold ores the color and form of the metallic particles are sometimes suggestive. Once, in Dakota, I was taken to see a vein said to be rich in silver, but the appearance of the vein-matter raised an immediate doubt as to what form the silver could be concealed in. By panning I obtained some native silver; but when examined under a glass some of the pieces showed traces of native copper attached. The only place I know where native silver and copper occur actually welded together is the copper region of Lake Superior; and, on questioning a little the honest miner who was my guide,—and who had kindly assisted in crushing some samples,—I found he had formerly worked on Lake Superior. No great intellectual effort was then necessary to account for the occurrence of the silver in the very unpromising looking vein-matter.

In the case of panning tests on gold ore, or gravel, or for precious stones, it is of course comparatively easy for anyone who is allowed to be within a short distance of the expert to get in his salting work, and solitude is the only protection. The salter may use a quill toothpick as a weapon for long-range shooting, or have gold dust in his nails for short range; or charge his pipe or cigar, and not watch where his ashes fall. Cases have been known of gold pans prepared in advance by a valuable varnish which gradually rubbed off in use. Although it is not possible to mention all the devices, there may be some utility in putting on record for others the better-known ones; for it is certain that many young engineers start out with confidence of much learning, ready to undertake responsible examinations, and without any clear idea of the dangers they are courting. A man may acquire a fair amount of practical experience, and confidence begotten of the same, without happening to get into surroundings of any real danger, and so, when least expecting it, may yet be nipped. All men of experience agree that the only absolute protection is solitude; and that trusting to knowledge of the old tricks or to personal watchfulness is quite insufficient if any person is immediately around.

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**A M S**.. Aust. Mining Standard. *w.* 30*s.* Sydney.
**A R**.....Architectural Record. *q.* $1. New York.
**Arch**.....The Archæologist. *m.* $1. Columbus, O.
**A Rev**....Architectural Review. *s-q.* $5. Boston.
**A S** .....Age of Steel. *w.* $3. St. Louis.
**A S I E** .Amer. Soc. of Irri. Eng. *qr.* $4. Denver.
**A S M E**.Am. Soc. of Mec. Eng. *m.* New York.
**B**..... The Builder. *w.* 26*s.* London.
**B A**... .The British Architect. *w.* 23*s.* 8*d.* London.
**B B**.....Brick Builder. *m.* $2.50. Boston.
**B G S**....Bul. Am. Geog. Soc. *q.* $5. N. Y.
**B I S** . ..Bul. Am. Iron and St. Asso. *w.* $4. Phila.
**B J C**....Boston Jour. of Commerce. *w.* $3. Boston.
**B M** ....Banker's Mag. *m.* 18*s.* London.
**B M A**...Bankers Mag. of Australia. *m.* $3. Melbourne.
**B T J** ...Board of Trade Journal. *m.* 6*s.* London.
**B U W**...Bul. of the Univ. of Wisconsin.
**C A**.....Calif. Architect. *m.* $3. San Francisco.
**Can A** .. Canadian Architect. *m.* $2. Toronto.
**C E** .....Colliery Engineer. *m.* $2. Scranton, Pa.
**C Eng**....Canadian Engineer. *m.* $1. Montreal.
**C G**.. ..Colliery Guardian. *w.* 27*s.* 6*d.* London.
**Ch**.....Chautauquan. *m.* $2. Meadville, Pa.
**C M**.....Century Magazine. *m.* $4. New York.
**C M R**...Canadian Mining Rev. *m.* $1.50. Ottawa.
**Com**.....Commerce. *w.* 36*s.* London.
**Cos**..... .Cosmopolitan. *m.* $1.50. New York.
**C R**.....Contemporary Review. *m.* $4.50. London.
**C T J**....Chem. Trade Jour. *w.* 12*s.* 6*d.* Manchester.
**D E**.....Domestic Engineering. *m.* $2. Chicago.
**E**.....Engineering. *w.* 36*s.* London.
**E A**.....Electrical Age. *w.* $3. New York.

E & C....Engineer & Contractor *w.* $1. San Francisco.
E A S....Eng. Asso of the South. *m.* $3. Nashville.
E E .....Electrical Engineering. *m.* $1. Chicago.
E E L....Electrical Engineer. *w.* 19*s.* 6*d.* London.
E E N Y..Electrical Engineer. *w.* $3. New York.
E G .....Engineers' Gazette. *m.* 8*s.* London.
E I .....Electrical Industries. *m.* $1. Chicago.
E L .....Electricity. *w.* 7*s.* 6*d.* London.
El. . . . .Electrician. *w.* 24*s.* London.
E M .....Engineering Mechanics. *m.* $2. Phila.
E Mag ...Engineering Magazine. *m.* $3. New York
E M J ...Eng. and Mining Journal. *w.* $5. N.Y
E N .....Engineering News. *w.* $5. New York.
Eng .....Engineer. *s-m.* $2.50. New York.
EngL... Engineer. *w.* 36*s.* London.
E N Y....Electricity. *w.* $2.50. New York.
E P .....Electrical Plant. *m.* 6*s.* London.
E R .....Engineering Record. *w.* $5. New York.
E Rev....Engineering Review. *m.* 7*s.* London.
E R L ....Electrical Review. *w.* 21*s.* 8*d.* London.
E R N Y..Electrical Review. *w.* $3. New York.
E S W P...Proc. Eng. So. of W. Pa. *m.* $7. Pittsburg.
E W .....Electrical World. *w.* $3. New York.
F . . . . .Forum. *m.* $3. New York.
F D .....The Foundry. *m.* $1. Detroit.
F R .....Fortnightly Review. *m.* $4.50. London.
F W .....Fire and Water. *w.* $3. New York.
F'y .....Fairplay. *w.* 32*s.* 6*d.* London.
G E M...Gas Engrs' Mag. *m.* 6*s.* 6*d.* Birmingham.
G & F....Garden and Forest. *w.* $4 New York.
G M.....The Geol. Mag. *m.* 18*s.* London.
G W ....Gas World. *w.* 13*s.* London.
H & V...Heating and Ventilation. *m.* $1. N. Y.
I A .....Inland Architect. *m.* $5. Chicago.
I Age....Inventive Age. *s-m.* $1. Washington.
I E .....Indian Engineering. *w.* 18 Rs. Calcutta.
I Eng....Indian Engineer. *w.* 20 Rs. Calcutta.
I & I.....Industries and Iron. *w.* £1. London.
I & S.....Iron & Steel Trades' Jour. *w.* 25*s.* Lond
I C B ....Carpenter and Builder. *w.* 8*s.* 8*d.* London.
ICT .....Iron and Coal Trades. *w.* 30*s.* 4*d.* London.
I I G.....Iron Ind. Gazette. *m.* $1.50. Buffalo.
Inv. . . .Invention. *w.* 11*s.* London.
Ir Age...Iron Age. *w.* $4.50. New York.
I R W. ..India Rubber World. *m.* $3. New York.
I S F.....Industry. *m.* $2. San Francisco.
I T R....Iron Trade Review. *w.* $3. Cleveland.
J A C S..Jour. Am. Chem. So. *m.* $5. Easton.
J A E S..Jour. Assoc. Eng. Soc. *m.* $3. Chicago.
J A N E ..Jour. Am. Soc. Naval Engineers. *qr.* $5. Washington.
J F I .....Jour. Franklin Institute. *m* $5. Phila.
J G L....Journal of Gas Lighting. *w.* London.
J N E W..Jour. N.E Waterw. As. *q.* $2. New London.
J P E.....Jour. Polit. Economy. *q.* $3. Chicago.
J S A....Journal of the So. of Arts. *w.* London.
L E..... Locomotive Engineering. *m.* $2. N. Y.
L. H. P..Light, Heat and Power. *m.* $3. Phila.
M .....Machinery. *m.* 9*s.* London.
M A. . . .Machinery. *m.* 50 cts. N. Y.
M & B...Manufacturer and Builder. *m.* $1.50. N. Y.
M E .....Marine Engineer. *m.* 7*s.* 6*d.* London.
Met W...Metal Worker. *w.* $2. N. Y.
Mill .....Milling. *m.* $2. Chicago.
Min. R...The Mining Review. *w.* $2. Denver.
M I T ...Mining Industry. *w.* $3. Denver.
Min W..The Mining World. *w.* 21*s.* London.
M J. . . .The Mining Jour. *w.* £1. 8*s.* London.
Mo ....The Monist. *qr.* $2. Chicago.
M R ....Manufacturer's Record. *w.* $4. Baltimore.
M S F....Master Steam Fitter. *m.* $1. Chicago.
M S P ...Min. and Sci. Press. *w.* $3. San Francisco.
M W. ...Mechanical World. *w.* 8*s.* 8*d.* London.
N . . . . .Nature. *w.* $7. London.
N A R...North American Review. *m.* $5. N. Y.
N B . . . .National Builder. *m.* $3. Chicago.
N C. ....Nineteenth Century. *m.* $4.50 London.
N C B...National Car Builder. *m.* $2. New York.
N S R....The New Science Review. *qr.* $2. N. Y.
N W .....Nowest. Architect. *m.* $3. Minneapolis.
P .....Paving. & Mun. Eng. *m.* $2. Indianapolis.
P A .....Progressive Age. *s-m.* $3. New York.
P E C P. Proc. Engineer's Club. *q.* $2. Phila.
P Eng...Practical Engineer. *w.* 10*s.* London.
Pl D .....Plumber and Decor. *m.* 6*s.* 6*d.* London.
Pr. .....Power. *m.* $1. N. Y.
P S M....Popular Science Monthly. *m.* $5. N. Y.
R A .....Railway Age. *w.* $4. Chicago.
R C J ...Railroad Car Journal. *m.* $1 New York.
R E M....Railway Engineering and Mechanics. *m.* $1. Chicago.
R G . . .Railroad Gazette. *w.* $4.20. N. Y.
R of R...Review of Reviews. *m.* $2.50. New York.
R P L....The Railway Press. *m.* 7*s.* London.
R R .....Railway Review. *w.* $4. Chicago
R W .....Railway World. *m.* 5*s.* London.
Ry T. . . The Railway Times. £1. 5*s.* London.
S . . . . .Stone. *m.* $2. Chicago
S A .....Southern Architect. *m.* $2. Atlanta.
San .....Sanitarian. *m.* $4. Brooklyn
Sc. . . . .Science. *w.* $5. Lancaster, Pa.
Sc A .....Scientific American. *w.* $3. New York.
Sc A S ...Scientific Am. Supplement. *w* $5. N. Y.
Sc M ....Scribner's Magazine. *m.* $3. New York.
Sc Q .....Scientific Quarterly. *q.* $2. Golden, Col.
S E .....Stationary Engineer. *m.* $1. Chicago.
S Ec ....Social Economist. *m.* $1.50, N. Y.
Sea .....Seaboard. *w.* $2. New York.
S In.....Stevens' Indicator. *qr.* $1.50. Hoboken.
S J E....Sibley Jour. of Eng. *m.* $2. Ithaca, N. Y.
S L .....Steamship. *m* Leith, Scotland.
S M .....Scientific Machinist. *s-m.* $1.50. Cleveland, O.
S M Q....School of Mines Quarterly. $2. N. Y.
S R .....Sanitary Record. *m.* 10*s.* London.
S R E N..St. R'y. Elec. News. *m.* $2. Minneapolis.
S P .....Sanitary Plumber. *s-m.* $2. New York.
S R G....Street Railway Gazette. *w.* $3. Chicago.
S R J....Street Railway Journal. *m.* $4. New York.
S R R. . .Street Railway Review. *m.* $2. Chicago.
S V .....Safety Valve. *m.* $1. New York.
T . . . ....Tradesman. *s-m.* $2. Chattanooga, Tenn.
T A I E E. Trans. Am. Ins. Elec. Eng. *m.* $5. N. Y.
T C E . . . Trans. Am. Soc. Civil Eng. *m.* $10. N. Y.
T Q .....Technology Quarterly. $3. Boston.
Tr .....Transport. *w.* £1. 5*s.* London.
Tr A M E. Trans. Am. Ins. of Mining Eng. N. Y.
T W A...Trans. of the Wis. Acad. Madison.
W E.....Western Electrician. *w.* $3. Chicago.
W R .....Westminster Review. *m.* $4.50. London

# ARCHITECTURE & BUILDING

### Insanitary Dwellings.

A MORE than ordinarily forcible and instructive lecture on uninhabitable and insanitary dwellings was recently delivered before the Unionist Club at Leith by Mr. William Stevenson, a house factor, as real-estate agents are styled in Scotland. Few real-estate agents in the United States could make such a deliverance. The lecturer aimed to point out some of the primary causes of insanitary dwellings, and to suggest what he thinks would be a successful remedy. The speaker first considered what has been asserted for the last 50 years to be the most potent cause,—reiterated as such at the Sanitary Congress in Glasgow last August by Dr. Russell, who laid the blame for insanitary dwellings on "the immoral compact entered into between the tenant and landlord," and, more rhetorically than logically, said that "this compact was leading landlords, factors, trustees, beneficiaries, bondholders, and tenants down the broad road to perdition." A political orator, Mr. Chamberlain, implied in a recent speech that houses became unhealthy because every man was not his own landlord, and named as the condition of healthy houses that they should be owned by their occupants. Mr. Stevenson, whose lecture is reported in *The Architect* (London, March 1), adduced strong evidence to prove that the opinions put forward by Dr. Russell and Mr. Chamberlain (but by no means confined to them) are fallacious. Edinburgh and Leith are cited as two cities preëminently characterized by ownership of homes by their occupants, and this ownership has extended back for generations. Of such of these houses (owned by their occupants) as have been built during the last 15 years, the lecturer queried whether one fourth would be found in a state to fully meet the requirements of tenants and stand modern scientific tests for sanitary conditions. How has it come about "that the houses that have been built even at a very recent date, and which, when built, were constructed on the most approved plan and fitted with sanitary appliances and other modern conveniences of the then most perfect kind should in a very few years become, so to speak, unhealthy?" This outcome of such ownership is explained as follows:

"I think it will be found that comparatively little is held in ownership by the upper or wealthy classes, but that it is held by the lower or less wealthy classes, not for speculation, but as a sure and safe investment, and held by persons who have acquired the means they are possessed of by care and frugality, and who have invested the whole, or nearly so, of their means in property as a competency for old age for themselves and wives, and with the expected reversion to their families or relatives after their death. In the investing of their carefully-gathered means little account has been taken of, and no provision has been made for, the continual outlay required for the repairs and up-keep which is necessary on house property. If money has been borrowed on bond and mortgage, as is often the case, the strain on the resources of the holding to make all ends meet is excessive. Every penny possible requires to be exacted from the rents by the life-renter. Not more than what is absolutely compulsory is expended either on repairs or improvements. The better class of tenants gradually remove to houses of more recent construction, and where they find the more modern appliances and conveniences. The houses have to be let to a class of more undesirable tenants, and gradually the property gets into disrepair, and from bad to worse goes down the hill, till ultimately, when it reaches the beneficiary, it is scarcely worth having." It is in this liability of houses to get out of repair, and the lack of adequate provision to keep them in repair, that the chief causes for existing insanitary conditions are found; and the lecturer, tracing

the various phases under which property is held by occupants, including life-rental, finds this cause at work among all the classes of individual owners of the property, except the wealthier classes. The remedy prescribed does not seem as practicable and adequate as the clear diagnosis of the disease might lead the reader to expect.

"I would like to see, and I recommend that the owning of house property be taken up by joint-stock companies, or such like corporations, or of some kind of syndicate, which might be limited, and might be coöperative. In the formation of such companies and corporations there could be no risk, if judiciously gone about. The property would be managed from year to year on uniform and business principles and with perpetual succession in the management,—uniform, continuous not erratic, spasmodic, and uncertain. The dividends would be paid half-year and half-year, uniform, and of known quantity, with sufficient reserve for all emergencies or improvements and for renewals. I see no reason why workingmen of all classes should not join in and invest their frugal savings in such a manner from the single one pound and upwards. Such investments would not be speculative,—expected to yield from 6 to 10 per cent.,—but I see no reason why a uniform and constant dividend of 4 to 4½ per cent. should not be made. In such companies, owning whole and undivided blocks of houses, and having no mutual obligations, improvements in internal arrangements and fittings, and the introduction from time to time of the modern and approved sanitary appliances, could be done with perfect facility and freedom, as it was found that they became necessary and advantageous for maintaining the houses in the best and most forward condition; and, by always keeping the houses in such forward condition and retaining and keeping the best class of tenants, maintaining the locality also in a high-class position. In such companies or corporations shareholders and members could with every confidence bequeath the life-rent to one person, and the fee in the reversion to others, knowing that the life-renter would have no control in deteriorating the principal, and that the fee would go down to the reversionaries unimpaired, and in the same substantial condition in which it was left at the date of bequest."

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### The American School at Rome.

THE New York *Evening Post* having printed a sketch of the origin and aims of the new School of Architecture at Rome, *Architecture and Building* (March 9) republishes the article, which relates to an important effort to improve American architecture and to afford increased facilities for improvement to advanced students after they have taken the courses now published in American schools of architecture. The object sought is the furtherance of "the work of the institutions in America now offering courses in architecture," thus promoting regular progressive academical training. The school "offers a post-graduate course, open only to the beneficiaries of the traveling scholarships connected with those institutions, to those who have acquitted themselves with signal ability in the examinations for those scholarships, and to members of the *École des Beaux-Arts* in Paris, of at least three years' standing. Other well-accredited students are admitted to certain hospitalities of the school at the discretion of the secretary. Cornell University, the Institute of Technology in Boston, Columbia College, and the University of Pennsylvania have well-established schools of architecture. Harvard University has taken significant steps toward the establishment of courses in architecture, and Yale University has them in contemplation. There are at present traveling scholarships at Columbia College, Cornell University, and the University of Pennsylvania, and, in addition, the Rotch scholarship in Boston, which is not connected with any institution."

An assurance that the work of organization is in excellent hands is afforded by the names of the managing committee, all in high esteem as practising architects or as instructors in the art. "The managing committee consists of R. M. Hunt, C. F. McKim, W. A. Boring, W. M. Kendall, Augustus St. Gaudens, J. Edward Simmons,

H. G. Marquand, Samuel G. Ward, and J. A. Garland of New York; R. S. Peabody and Martin Brimmer of Boston; D. H. Burnham and Franklin McVeagh of Chicago; George E. Leighton of St. Louis; and the chiefs of the departments of fine arts or of architecture in the principal institutions which maintain courses in architecture, — namely, Prof. Norton of Harvard College, Prof. Babcock of Cornell University, Prof. Chandler of the Massachusetts Institute of Technology, Prof. Ricker of the University of Illinois, Prof. Ware of Columbia College, and Prof. Laird of the University of Pennsylvania."

At a meeting held at the Century Club, New York, June 12, 1894, an executive committee was appointed and instructed to select a managing committee. Notwithstanding that a year has not passed since this action was taken, it is stated that "the institution has already developed into an undertaking of much greater magnitude than at first was contemplated." The consensus of opinion with those interested in the enterprise is in favor of directing the work of beneficiaries to a common purpose, instead of, as heretofore, permitting them to travel from place to place, "filling their sketch-books with miscellaneous material and sending home but few carefully-measured drawings," this kind of work evincing "individually little intelligent prosecution along consistent lines." It was therefore finally decided to found an institution upon a broader basis than the atelier at first proposed, and "one which in the course of time should equal in endowment and advantages the foreign academies at Rome, although somewhat different in its scope and object."

Prolonged stay is to be encouraged for the purpose of more thorough study and the acquisition of an "application of true spirit of classic art."

"The school was formally opened under the charge of Austin W. Lord as secretary, and began its work on the 1st of November last in eight rooms, occupying the upper story of the *Palazzo Torlonia*, on the southwest corner of the *Via Condotti* and the *Via Bocca di Leone*, between the *Corso* and the *Piazza di Spagna*. In the absence of settled organization, it will require another term before the school may be said to be fairly launched, but it is satisfactory to note that the four traveling scholars this year abroad there have been following the course of the school." Departments in painting and sculpture are to be established. An extension of the scope to include archæology and epigraphy is to be considered at the May meeting of the Archæological Institute in Philadelphia.

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### Designing a Hotel.

BELOW is a condensation of an abstract printed in *The British Architect* (March 1), made from a report by Mr. W. Hamilton Beattie, accompanying a design also prepared by him for the New Edinburgh Railway Hotel and offices for the North British Railway Company. The design submitted by Mr. Hamilton was accepted, and the building will be erected accordingly. The purposes to which the design has been made subservient are apparent in what follows:

The plan must be simple, with straight, well-lighted corridors and easy and readily-found staircases and elevators. The guest, on arrival, must be able at once to reach the office to procure his room, and to proceed there directly, without delay or *détour*, which are most aggravating to a tired traveler. In a hotel where travelers arrive and depart on two different sides of the building and on entirely different levels this necessitates two offices. The hotel office should command the principal entrances, so that every one entering or leaving the hotel may be under supervision.

The public rooms should have the best views, and should be in such positions as will be most convenient for the special class of guests chiefly using them, and as will cause the least interference with guests not using them. For example, the smoking-room and billiard-rooms should be in readily-accessible, but retired, situations, where they will not interfere with the comfort of the lady guests. The children's room should also be in such a position as will not annoy the more important guests.

The kitchen should be large, well-

lighted and ventilated, and in a central position, from which rapid service of food may be made to every apartment in the hotel requiring it. Nothing aggravates guests more than slow service or cold food. All the administrative apartments should cluster round the kitchen in a compact and easily-accessible plan, so as to secure the smooth working of the establishment and an absolute check upon all stores arriving or being issued, and upon all cooked provisions or liquors being sent to the visitors.

The working arrangements should be planned so that the hotel may be run with the minimum staff of servants, and so that the last ounce of value may be got out of all fuel and other stores used. For example, the same steam-boilers should provide the motive power for heating, cooking, washing, ventilating, electric light, elevators, &c., and, as in a triple-expansion engine, the heat should be utilized to the last possible degree. Outsiders have no idea of the large sums which may be saved in the working of a hotel by the careful planning and economical combination of these arrangements.

The bed-rooms should be of fair size and varied in dimensions, so as to accommodate both married couples and single visitors. The shape of hotel bed-rooms is somewhat important, as they are more occupied than in private houses, and, in addition to the usual furniture, have also to accommodate trunks and travellers' luggage. The best shape has been shown by experience to be a long parallelogram. On the principal floors there should be suites of sitting-rooms, dressing-rooms, and bath-rooms to meet the requirements and purses of wealthy travellers. Careful provision should be made for the rapid and efficient service of both the private sitting-rooms and the bed-rooms upon each floor, and for a prompt attendance on visitors' rooms both day and night. Nothing makes a hotel more unpopular than defective service and delays in answering bells. The measure of the earning-power of a hotel is the bed-room accommodation, and the more numerous its rooms are, the better it will pay; especially in the upper flats is the number of bed-rooms more important than their size.

Everything connected with a hotel should, as far as possible, be done on the premises. For example, by having an efficient washing-house and laundry, the profit from the washing of the visitors' linen will nearly cover the cost of doing up the hotel, bed, and table linen, and the hotel servants' washing. Moreover, the washing is done better and quicker than outside, and delays and losses with visitors' washing avoided. Another most profitable arrangement is for a hotel to bake its own bread. In these days of cheap corn the profit earned is large, and will keep the hotel servants in bread for nothing.

Every first-class railway hotel should do an extensive restaurant and bar business. This is very profitable, and can be easily managed in connection with the hotel. Every first-class hotel should do a wine and spirit merchant's business, and should have a special shop or office for conducting it. Considerable stocks of wine and spirits must be kept and matured by the hotel, and it greatly increases the turn-over when these are sold in larger quantities.

The arrangements for the housing of the hotel servants should be carefully considered. These have hitherto been much neglected, which is a serious mistake, as good servants will not remain unless they are made comfortable. Hotel servants are notorious for their constant changes and bad qualities, and this, to a considerable extent, arises from the way in which they are treated as regards feeding and sleeping, accommodation, baths, and sanitary arrangements. It pays well to make them comfortable in these respects. It is hardly necessary to add that the number of servants bears a fixed proportion to the number of guests, and that servants' accommodation must be provided accordingly. If this is not done, the servants must occupy bed-rooms that could otherwise be let to guests.

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### How to Prepare Mortar.

ENGINEERING, N. Y. (March 16), contains a letter from Mr. Edward Wolff, which, in view of recent occurrences in

New York, is of interest as showing defective methods of mortar-making employed by builders, and as giving the proper method of slacking lime, preserving it in good condition after slacking, and preparing from it strong, adhesive mortar.

"The slacking operation should be done in a water tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slacked lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas having not been able to find access. Instead of following the procedure in slacking lime recommended above, we see in this country, or at least in the neighborhood of New York, a faulty process adopted, which consists in loosely mixing the sand with the slacking lime immediately after water has been added, and forming a dry heap on the surface of the ground, which is left lying there several weeks to give time for complete slacking before the sand is worked in evenly and the mortar considered ready for use. This heap arrangement is perfectly adapted to circulating air through a material which should be guarded against contact with air. The sun heats the surface of it, makes the air escape after it has given up its share of carbonic-acid gas, while at the base of the heap and at the shady side a fresh supply enters to fill up the vacuum after it has circulated through the heap and has been robbed of its share of carbonic-acid gas. That this procedure really happens in such a heap we can easily see when we place a lump of freshly-slacked lime in a wine-glass and in another glass place a small quantity of material taken from a heap such as described, and which has been prepared a few days before; fill both glasses nearly up with water, and add a few drops of muriatic or sulphuric acid to each. In the first glass nothing can be observed, while in the second glass we will see in the shape of small bubbles the carbonic acid escape, which has been absorbed by the lime from the atmospheric air circulating in the heap." It is reasoned that, as the hardening of mortar after mason-work results from slow absorption of carbonic acid from the air, if this be allowed to take place to any considerable extent before the mortar is used, a granular and non-adhesive condition of the mortar results, and a strong wall can not be made with it.

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### Padauk.

THE above is the name of a tree whose wood seems likely to come into favor for ornamental purposes, and which is even now being exported in considerable quantities from East Indian ports, chiefly to France and Belgium. *The Indian Engineer* (Jan. 5) gives a description of this tree and its timber, which certainly seems to be a remarkable material. It is much denser than teak, weighing from 56 to 80 lbs. per cubic ft. White ants do not attack it, probably on account of its density, but possibly because of a peculiar principle contained in its sap, which, when evaporated, yields a gum very similar to, if not chemically identical with, the gum Kino used in medicine. The tree sometimes grows to a great size. A plank of the timber 4 ft. wide was sent to the last Paris Exhibition, at which also its possibilities for furniture were displayed. However, the squared logs exported are usually about 16 ft. long and about 1 ft. 6 in. in thickness. The color of the wood varies from a color darker than mahogany to a flame-red, the latter being the favorite color. The roots are much more finely colored and marked than the trunks of the trees. The wood is said to season well and work well, and to be capable of taking a fine polish. It costs more to work than mahogany, but the extra cost is said to be repaid by the beauty of the finished product.

It is stated that the effects obtainable by the use of padauk wood for furniture and for interior architectural work are only rivaled by the richest and most perfect specimens of Spanish wood. Under the process of polishing, the figure in the wood, as well

as the tone and color, becomes rich and beautiful. A very fine dado for a stone staircase in a London (Fenchurch street) church is cited as an example of the beautiful effects attainable, and a description of a drug store fitted up with doors and windows of padauk is quoted from *Timber*, which states that the effect is unique, and that both the color and figure of the wood are all that can be desired.

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SPEAKING of principles that should guide repair of Ancient Buildings *The British Architect* says: "There has perhaps been no more abused term than that of "judicious restoration." Under cover of this elastic definition many an old historical structure has been divested of its main interest and charm. Possibly we are growing a little wiser and more discerning, and consequently the rage for "restoring" anything and everything — even with enamel paint—has in some sort abated. Modern imitation of old work is to be deprecated.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Architecture and Building in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

†29154. Padauk. Editorial (I Eng-Jan. 5.) 1500 w.

*29956. The Proposal to License Architects. John Beverley Robinson (E Mag-May.) 3000 w.

29965. The Proposed Tenement House Law. Editorial (A & B-March 9.) 900 w.

29967. The American School of Architecture at Rome. From the N. Y. Evening Post (A & B-March 9.) 2000 w.

29968. The Licensing of Architects. A Plea Against Professional Disgrace. Barr Ferree (A & B-March 9 ) 3000 w.

29971. Wrought-Iron Work in Charleston, S. C. From the Charleston Sunday News (A A -March 9 ) 1700 w.

29972. The Value of Sentiment. Address of Col. Henry Lee in Favor of the Preservation of the Boston State-house (A A-March 9.) 3000 w.

*29978. Malmesbury Abbey. Ill. R. W. P. (B-March 2 ) 3000 w.

*30021. Uninhabitable and Unsanitary Houses. William Stevenson (A L-March 1.) 3500 w.

*30023. Design and Materials. P. Morley Horder (B A-March 1.) 1700 w.

*30024. Hotel Designing. W. Hamilton Beattie (B A-March 1.) 1000 w.

*30029. Rules to Be Observed in Planning and Fitting Up Public Elementary Schools (I C B-March 1.) 3000 w.

*30030. The Architecture of Theatres. Anon. (I C B-March 1.) 900 w.

30120. Mortar—How and How Not to Prepare It. Edward Wolff (Eng-March 16.) 1500 w.

30127. An Architectural License Law Should Be Passed. Letters from Warren R. Briggs and William T. Hallett (A & B-March 16 ) 2800 w.

30131. The Mercantile Club House in Philadelphia Ill. (E R-March 16.) 2800 w.

*30161. The Perspective of Buildings. From the Building News (I C B-March 8.) 2000 w.

*30163. Natural and Artificial Marble. Anon. (I C B-March 8.) 2300 w.

*30164. Stucco. Anon. (I C B-March 8. 1400 w.

*30174. Plaster Work. (Extract.) F. W. Pomeroy (B-March 9.) 2700 w.

*30206. The Late Hyde Clarke on Color (A L-March 8.) 3500 w.

*30209 On the Painting of Stucco. William Fourniss (Pl D-March.) 1200 w.

*30211. The Mediæval Glazier. (Extract.) Lewis F. Day (Pl D-March.) 1800 w.

*30213. Some English Cathedrals. (Extract.) Alfred Darbishire (B A-March 8.) 700 w.

*30237. Granites of Germany, France and Belgium. (Extract.) Hjalmar Lundbohm (S-March.) 2500 w.

*30238. Sioux Falls Jasper Granite. Ill. Anon. (S-March.) 1500 w.

*30239. The Slate Roof. G. B. Benford (S-March.) 1600 w.

30329. The New Lien Law of New Jersey. Full Text. (A & B-March 23.) 1300 w.

30337. Bramante and St. Peter's. H. Mereu (A A-March 23 ) 2700 w.

†30353. The Point of Departure Between Classic and Mediæval Architecture. Ill. P. B. Wight (I A-March.) 3200 w.

*30390. John Bernard Fischer. Anon. (A L-March 15.) 2300 w.

*30391. Some Principles Underlying Domestic Architecture. (Extract.) R. Barry Parker (A L-March 15.) 5300 w.

*30416. Building Construction in Its Relation to Fire Protection. Editorial (Can A-March.) 1800 w.

*30417. Paper on "English Methods." Frank Baker (Can A-March.) 2400 w

*30418. Points on Acoustics. David Gunn Baxter (Can A-March.) 1600 w.

*30419. A Chapter from My Note Book.—Building Methods in Rome. M. B. Aylesworth (Can A-March.) 4500 w.

*30420. The Æsthetic Unity of the Fine Arts.—More Especially in Relation to Architecture. Hamilton MacCarthy (Can A-March.) 4000 w.

*We supply copies of these articles. See introductory.*

*30421. Building Laws of Roanoke, Va. (S A-March.) 600 w.

*30422. Government Architects.—A Comparison of Their Work With That of the Profession. C. H Read, Jr. (S A-March.) 2800 w.

*30423. A Suggestion for Popular Education in Architecture. Editorial (S A-March.) 2400 w.

*30424. Beams and Girders and Their Relation to Structural Architecture. Ill. J. G. Longstreet (S A-March.) 2000 w.

*30425. Coloring Outside Woodwork. Editorial (I C B-March 15.) 700 w.

*30426. Bricks and Brickwork. Anon. (I C B-March 15.) 1500 w.

*30428. Common Sense in Building. Anon. (I C B-March 15.) 1200 w.

*30429. Painting a Room. By an Old Hand (I C B-March 15.) 1000 w.

*30491. Various Systems of Concrete Construction. Ross F. Tucker (B B-March.) 1500 w.

30503. Some Comparative Tests of Building Stones. Ill. Coles A. Raymond and Edward W. Cunningham (E N-March 28.) 3300 w.

30514. Is the Commission Basis the Proper Method of Estimating Architectural Services? Editorial (A & B-March 30.) 1200 w.

30516. Architectural Illustration. C. G. Harper (A & B-March 30.) 2500 w.

30519. Ramblings in Sherborne, Wilts, England. Sophia Beale (A A-March 30) 2800 w.

30523. The Ethics of Architectural Practice. From the N. Y. Evening Post (E R-March 30.) 1700 w.

30539. High Chimneys—Their Advantages, Economical and Sanitary. Ill. W. Barnet Le Van (M A-April.) 1500 w.

*30582. The American School of Architecture at Rome (A L-March 22.) 1500 w.

*30586. The Planning of Small Houses. T. W. F. Newton (B A-March 22.) 1100 w.

*30591. Comparisons and Contrasts in Architecture. (Abstract.) Banister Fletcher (B-March 23.) 1300 w.

*30592. Colored Decoration of Architecture. J. D. Crace (B-March 23.) 1800 w.

30687. Construction of a House of Constant Temperature. Ill. From La Nature (Sc A S-April 6.) 1000 w.

30716. The Underpinning of the High Court Building, Calcutta, India. Ill. Abstract from report of Charles Warde (E N-April 4.) 600 w.

30742. The March Grand Jury's Recommendations as to the New York Building Department, with Editorial (A & B-April 6.) 1400 w.

*30768. New Methods and New Materials (B A-March 29.) 1000 w.

30804. The Boston Public Library (A A-April 6.) 1700 w.

*30814. Terra Cotta. Anon. (I C B-March 29.) 1200 w.

Serials.

12568. Building Construction and Superintendence. Ill. F. E. Kidder (A & B-Began May 6, 1893—41 parts to date—15 cts. each).

18737. The Engineering of Architectural and Building Construction. William H. Burr (E R-Began Jan. 6, 1894—10 parts to date—15 cts. each).

18857. Electrical Science for Architects. Ill. Russell Robb ( A A-Began Jan. 13, 1894—9 parts to date—15 cts. each).

19078. Problems in Stone Cutting. Ill. Ed. W. Hind (S-Began Jan., 1894—12 parts to date—30 cts. each).

19713. Brick and Marble in the Middle Ages. Ill. G. Edmund Street (B B-Began Jan., 1894—15 parts to date—30 cts. each).

20419. Modern Methods of House Painting. A. Ashmun Kelly (Pl D-Began March, 1894—12 parts to date—30 cts. each).

21288. Theatres. Ill. E. A. E. Woodrow (A A-Began April 14, 1894—14 parts to date—15 cts. each).

21736. The Art of Building Among the Romans. Ill. Auguste Choisy. Translated by Arthur J. Dillon (B B-Began April, 1894—11 parts to date—30 cts. each).

26069. Modern Steel Fireproof Construction. Ill. F. M. Small (A & B-Began Oct. 13—5 parts to date—15 cts. each).

26070. The Planning and Construction of American Theatres. Ill. William H. Birkmire (A & B-Began Oct. 13, 1894—6 parts to date—15 cts. each).

27036. The Basilica and Its Adaptation to Modern City Churches. Ill. George Ashdown Audsley (A & B-Began Nov. 24, 1894—5 parts to date—15 cts. each).

28494. Bricks and Terra Cotta (B-Began Jan. 5—11 parts to date—30 cts. each).

28805. Fireproof Floor Arches. Ill. George Hill (B B-Began Jan.—3 parts to date—30 cts. each).

29200. The Advancement of Architecture. Professor Aitchison (B-Began Feb. 2—6 parts to date—30 cts. each).

29253. The Guilds of the Medieval Workers in Stone. Edward C. Weaver (S-Began Feb.—2 parts to date—30 cts. each).

29358. Hints to Art Students on Travelling Abroad. J. W. Case (A A-Began Feb. 16—4 parts to date—15 cts. each).

29581. Ornamental Iron Arches. Ill. Archie (B B-Began Feb—2 parts to date—30 cts. each).

29969. The Tenth League Exhibition. Anon. (A A-Began March 9—2 parts to date—15 cts. each.

30589. St. Sophia, Constantinople. Ill. (B-Began March 23—Ended March 30—2 parts—30 cts. each).

30812. The "Sky Scraper." F. C. Gordon (I C B-Began March 29—1 part to date—30 cts).

*We supply copies of these articles. See introductory.*

# CIVIL ENGINEERING

*For additional Civil Engineering, see "Railroading" and "Municipal Engineering."*

**The Santa Ana Irrigation Canal.**

AN abstract of a paper by Mr. Ham Hall (read Feb. 5 before the American Society of Civil Engineers) in the *Railroad Gazette* (March 29) presents some interesting facts relative to irrigation practice in California. The canal is designed to take water from the Santa Ana river for irrigating 45,000 acres of land in the northern portion of San Jacinto plateau, the supply being "reinforced, when necessary, by water from a storage reservoir in the San Bernardino mountains, impounded during the flood period."

Only divisions I and II are discussed in the paper, these portions being now completed to about one-half capacity. A remarkable feature of the work is the tunneling involved in it. "Nine mountain spurs are pierced by tunnels, whose aggregate length is 4329 ft. Three large transverse cañons are crossed by pressure pipes, with a total length of 2127 ft.; nine reaches of flume have an aggregate length of 11,394 ft.; one piece of walled canal has a length of 152 ft.; and eight masonry structures cover 173 ft. in length of line. There are thirty-nine substructures, consisting of girders or combination Fink truss spans, with an aggregate length of 1905 ft."

"In division II, as now finished, there are eight stretches of canal, with a total length of 8214 ft., nearly all lined with rubble in mortar. There are seven reaches of flume, aggregating 2706 ft., crossing six gulches and the wide torrent-bed of Mill creek. The gulch crossings are supported by string girders and wooden piers on masonry footings, with an aggregate length of 1440 ft., and Mill creek crossing is made by a riveted steel bridge 1072 ft. long."

"Of the nine tunnels in division I eight are through rock, and were driven by contract. The ninth, through cemented gravel and boulders, was driven by day labor. The specifications under which contracts were let provided that the contractor should furnish all the material, tools, and outfit, except the lumber for lagging and timbering. All tunnels were uniform in cross section, provision being made for variation in excavated section where timbering would make it necessary."

In tunnel No. 9, which is 510 ft. long and was subject to air-slacking, a "special experiment in the use of wood lining was introduced. The lining is made of 3 in. redwood staves, pressed into place and held within a shell formed by ramming concrete as backing into a space between the staves and the face of the tunnel bore. To preserve the wood this tunnel is located more than its diameter below the grade, so that, no matter how little may be running, the staves remain always thoroughly soaked. The lining was built in lengths of 8 to 14 ft. each. The staves of the succeeding lengths were broken-jointed, with an end lap of 4 in., and the end joints were made between each two abutting staves, with a metal tongue taken into a saw kerf in the staves' ends. The staves were a little less than 8 in. wide, with the edges milled to radial lines of the circle, and with a ⅛-in. bead on each edge one third the thickness from one side. The entire tunnel proper will be under a pressure head of between 1 and 3 ft. at its top plane when there is any water whatever running in the aqueduct, and between 7.3 ft. and 9.3 ft. when the full 240 second-feet are flowing. At the up-stream end it flares in 16 ft. of length to an oval, having horizontal and vertical axes of 114 and 72 in. respectively. This was done to receive, with the least disturbance of current, the water from two 52-in. pressure pipes laid side by side and 6 in. apart. There is a gateway provided at the down-stream portal to close it sufficiently to always keep the wood lining of the down-stream extension wet, no matter how little water may be running."

"Calking was resorted to whenever there was any indication that a seam was not thoroughly closed. Such lining guards

better against rupture by earthquakes than any other, and the planed wooden face diminishes friction and materially increases capacity. The wood lining cost $4.28 per linear foot, and the lining complete $8.11; the tunnel complete $12.64."

"The three pressure pipes of the line cross three cañons. They are pipes made of redwood staves, bound with round steel rods, with the end joints closed by metal tongues let into saw kerfs in the stave butts. They were used instead of iron or steel to save expense, and also because they could be laid wholly above ground and thus save cost of excavation and back filling, whereas, owing to the temperature, metal pipes would have required covering."

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### Great Tunnels of the World.

MR. ROBERT JAMISON, writing for the April number of *The Chautauquan*, thinks the burrowing of the common field mole suggested tunneling to the ancients; but why the mole, any more than the marmot or other burrowing animal, does not clearly appear. Whatever suggested tunneling, whether animal burrowing, or natural tunnels or caverns, it is quite certain that artificial tunneling for the service of man is of very ancient date. Rock-cutting and earth-excavation are among the oldest of arts. The catacombs at Rome and the Indian temples wrought from solid rock are illustrations of this assertion. The rock-cutting and earth-excavation of the present era are incomparably more rapid than the laborious processes of the ancients; and the comparative ease with which this sort of engineering work can now be performed through the use of compressed-air rock-drills, steam and electric rock-drills, and the employment of high explosives, renders almost any reasonable scheme of tunneling or excavation acceptable in plans for great railroads, or even for ship canals. In fact, if our memory serves us, a famous engineer once said he would undertake to tunnel straight through the earth from New York to Pekin, if anybody would furnish capital for the enterprise.

Mr. Jamison has compiled some interesting facts anent the famous tunnels of the world. "There are to-day over one thousand tunnels on the lines of the world's railroads." It is only about 25 years since tunneling was all done with hand-drills and gunpowder blasting. With improved methods and railway extension, tunnels miles in length have come to be not infrequent. The great Simplon tunnel, when completed, will be 11 miles in length. Tunnels of from 3000 to 7000 ft. "were once considered as important." They are now only commonplace. "The first really great railroad tunnel was The Hoosac. Projected in 1854, it was not finished till 1876, after 22 years of labor, delays, failures, and final success. This, the first of the great quartet of mountain tunnels, is 4¾ miles long and cost $10,000,000, or $379 a running foot. The two mountains under which the Hoosac passes are 2504 ft. and 2212 ft. above the sea level, and there is a deep valley between them. In this valley a shaft was sunk 1028 ft., and headings were cut in both directions from the bottom of the shaft. This made it possible to work in four directions at once. The highest peak of the mountain is 1700 ft. above the floor of the tunnel. The rock through which the tunnel is cut varied somewhat in strength, and the softer and weaker parts are lined with masonry. From the commencement of the work in 1856, including delays, up to 1866, all the drilling was done by hand. Then the compressed-air rock-drill came into practical use, and the building of great tunnels rose to the dignity of a great science."

The length of a tunnel, within reasonable limits, is no longer a serious difficulty. Neither is it very difficult to supply light and air to long tunnels. The electric light and the modern pneumatic appliances have reduced these old-time difficulties almost to zero.

The author intimates that the long-mooted tunnel under the English channel would have been a fact before this time, were it not that "Englishmen and Frenchmen are so ignorant of each other that they are afraid to shake hands under the sea." Some might think, however, that a

better reason for such a fear is that ancient feuds have made them too well acquainted with each other's tricks and manners to unite in such a scheme.

"Of the quartet of great tunnels—Hoosac, Mont Cenis, St. Gothard, and Arlberg—the first only was built absolutely without thought of its political significance or military value. Mont Cenis is a gateway in the boundary line between Germany and Italy, and Arlberg is still a different gate in the great mountain barrier between these nations. The value of these great tunnels between nations is in large degree dependent on this very fact. They unite one great power with other great powers. No single railroad company could build them; perhaps no single nation could or would undertake their construction. Combinations of nations alone could carry out such enormously costly undertakings. Grouped together for comparison, we find that Mont Cenis, 7⅝ miles long, cost $15,000,000; St. Gothard, 9¼ miles long, cost $11,175,000; and Arlberg, 6⅜ miles long, cost $7,300,000. It took 14 years to build Mont Cenis, 9 years to build St. Gothard, and 5 years to build Arlberg. From the start these great tunnels employed power drills and every possible aid and appliance of modern science. They are indeed the great engineering works of the world."

The tunnel under the Thames river is the first important sub-aqueous tunnel. It was projected in 1798 and completed in 1843. It is a mere baby to what has since been done in this line. The tunnel under the St. Clair, 6050 ft. long; that under the Severn, a little over 4 miles long; the Mersey tunnel, 23,615 ft. long,—each affording passage for great railways,—dwarf the Thames tunnel (in its day considered a great achievement) into utter insignificance. The Hudson river tunnel, if it ever be completed, will take rank among the greatest sub-aqueous tunnels of the globe.

The great Sutro tunnel at the Comstock Lode is probably the most important of all mining tunnels, though hosts of other mining tunnels might be named. If all the tunnels existing could be strung together in a direct line through the earth from New York to Pekin, as was facetiously proposed, they would reach through a notable fraction of that shortest line between these cities.

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### Masonry Dams.

THE ENGINEER (London, Feb. 2) gives editorially a caution against too firm a reliance upon mathematical results in computations, except where the constants employed are all experimentally and thoroughly established. When any assumption of a constant is made without experimental determination, a mathematical computation may lead to very inaccurate results. The editorial then proceeds to point out that just such assumptions enter into mathematical calculations in the designing of masonry dams. For instance, in the matter of elasticity of masonry and of mortar the modulus of elasticity is assumed as constant, whereas Sir Benjamin Baker found it to vary for both materials from one to five. And this modulus varies in the same specimen with the values of the stresses put upon it, so that our contemporary thinks that "of all misnomers that of 'constant' applied in the manner indicated is most flagrant." The analytical methods of the French engineers, followed up in England by Rankine, have evolved "a form of high masonry dams far superior to the old or trapezoidal type."

"With the same margin of stress, the latter form required twice the quantity of material, which is probably the reason some of them have stood very well. Nevertheless, the necessity for employing a section of minimum area and of correct form is obvious, and not only on the score of economy, but of security also. A mass of masonry built in the wrong place in a dam is equally productive of disastrous consequences as would be a large quantity of material erroneously located in the design of a bridge, roof, or any engineering structure. In fact, many instances have occurred in which dams designed upon the old principle have completely collapsed. As they were most of them of the trapezoidal form, the failure could not be traced

to an insufficiency of material, but was unquestionably due to an irregular and faulty distribution of it A good deal of discussion and comment has been called out by the assertion that the so-called Rankine's section of a dam is wasteful of material. Taking into consideration the pros and cons on the question, which include the opinions of some of our most eminent engineers, we are disposed to think that the statement is not entirely without foundation. We do not endorse the statement which has been made that, in adopting Rankine's section, the redundancy of the cross sectional area reaches the exorbitant proportion of 43 per cent., because the assertion is incorrect, although at the same time, curiously enough, it is in one sense true. This apparent paradox needs some explanation. It is true that, by applying the section in question to a dam of moderate height, the excess of material would be fairly represented in the upper portion by that percentage; but Rankine not only never intended that his section should be of universal application to any height of dam, but expressly stated so He, in fact, pointed out that the section was not suitable for dams of less than a certain height, and demonstrated the correct method for making a corresponding reduction in the section. So far, so good; but it does not appear to be controverted that even in adapting his section to high dams, for which it was originally intended, there does result a certain waste of material, although not to any extent approaching the amount erroneously attributed to it when employed on a small scale."

In view of all this, and "granting for the sake of argument" that the form of the modern dam is more economical, it is concluded that this is not a reason why "a somewhat differently proportioned and contoured section may not have equal stability, and afford equal security against accidents. While due regard should be had to economy in the design and construction of all engineering undertakings, yet, in consideration of the enormous interests involved in the safety of a structure like the Vrynwy dam, there are some questions that should take precedence over all others." Neglect to properly consider the length of the maximum section as well as its height, on account of the greater attention the latter demands, is charged as being sometimes a fault in designing. For instance, such a dam as the Vrynwy, which has a maximum section extending over a length of 600 ft., receives no lateral support from the wings; and it is thus concluded that a section suitable for a narrow gorge might be wholly unfitted for a wide dam like the Vrynwy.

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### The Manchester Ship Canal.

THE half-yearly meeting of the stockholders of the Manchester Ship Canal Company does not appear to have been altogether a love-feast. Some caustic speeches were made, and *Transport*, which gives an account of the meeting, says "it is evident that the directors have come nearly to the end of their tether." The ordinary shareholder finds himself in the position usually attending the threatened financial collapse of corporate enterprise. *Transport* thinks that perhaps something may be hoped for from the patriotism of the citizens of Manchester, which may prove sufficient to save the undertaking from utter failure; but, if this prove to be a correct prognosis, it will not help the present shareholding interest. "The inevitable crash can neither be averted nor postponed for any length of time."

This outcome is not a surprise to those who have carefully observed the management of the company's affairs. "It has long been evident to all who followed closely and intelligently the financial and commercial outlook that the canal was a foredoomed failure. Misleading estimates as to capitalization, misleading estimates as to traffic and revenue, have filled the public with disgust, and overwhelmed the project in certain disaster. It is idle, it is simply begging the question, to say that such a conclusion is premature. What hope is there that next year's result will be materially better than the one which has just closed? Such platitudes as that new enterprises expand slowly, that the avenues of commerce are difficult to change, and

that competing interests fight bitterly to hold their own, can deceive nobody now. The voice of the enchanter has lost its magic power. The spell of the magician is gone. It is harder to attract a few thousand tons of traffic than to draw millions from the pockets of the confiding investor. The canal authorities never concealed their light under a bushel. The waterway was opened with all the pomp that royalty could give, and Lancashire turned out in millions to rejoice in the event. Such was the general enthusiasm pervading all classes, from the highest to the lowest, that it may be safely assumed that whatever business men could give in the way of trade was given with no niggardly and stinting hand; but they could not be expected to make great personal sacrifices to inaugurate a brief period of inflated prosperity for an enterprise which they must have seen could never exist on a stable basis."

The statement that the enterprise has suffered through misrepresentations of interests affected adversely is characterized as "simply childish." The plain facts appear to be that a great engineering work has failed to be remunerative, and that this is largely due to its mismanagement. The cost of the entire work has been £15,000,000, or more than double the original estimate, and the traffic estimates of the manager have been as gravely inaccurate as those of the engineers.

"At the present time the annual obligations of the company amount to £331,280. The receipts on the revenue account amounted to £53,593, and the working expenses to £42,595, showing a balance of £10,998. Add to this the profits of working the Bridgewater canal, and the total is brought to £36,870. Up to the present, interest on the existing obligations has been met by the accumulated profits of the Bridgewater undertaking; but the unapplied balance has now been reduced to £34,700, so it is clear that fund will no longer be available."

It is hoped the lesson of this enterprise may not be lost upon American investors. Ship-canal schemes are now as plenty as blackberries on this side of the water, but somehow most of them do not seem to progress very much beyond the scheme stage. It is, however, not improbable that, when prosperous times return, some of them will get launched. The lesson of the great Manchester ship canal ought to teach the dangers incurred in this class of investments.

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### A New Darien Ship-Canal Route.

ITEMS relating to a new canal route across the Isthmus of Darien having of late been current in the daily press, *Engineering News* (March 4) obtained the particulars of the scheme and published them in connection with a map of the route herewith reproduced. It is stated that this route has been discovered by Mr. Gustavus A. Karwiese, who claims to have been investigating ship-canal routes in Central and South America for the last 28 years and to have "made personally eight instrumental surveys of the route under consideration." The only material available for forming a judgment of the feasibility of the route are the map and the statements of Mr. Karweise, whose estimates are based upon confessedly incomplete data.

The proposed route is from the Gulf of Darien to the Bay of San Miguel, through the State of Columbia and south of the Panama Canal concessions. "Mr. Harweise says that, commencing on the Pacific side, there are about 11 miles of free navigation up to the Bay of San Miguel and the Tura river, and he proposes to dredge out and rectify the remaining part of this river up to the point H, on the map, where he locates his first tidal lock, about 60 miles from the Pacific, along the present crooked course of the river and bay. He claims that there is 38 ft. of water for about 11 miles of this line, and that over the remainder dredging is easy.

"He commences what he calls his canal proper at the point H, and follows the Javiesa river and valley until the main ridge of the Cordilleras is reached at T, where he proposes a tunnel 11,880 ft. long through the mountain. His canal terminates between Capes Acanti and Tolo, on

the Gulf of Darien, in a naturally protected harbor. The length of this section he fixes at 28⅝ miles, that is, from the lock at the point H to the Darien entrance lock at B. And from the Pacific ocean to the gulf the distance would be about 93½ miles, on the line described."

"The summit of the Cordilleras at the point tunneled is 1180 ft. above the sea level, and, as he proposes a tunnel 88 ft. wide and 112 ft. high, this would leave nearly 1000 ft. of solid rock over the crown of the tunnel. For the 28⅝ miles of canal excavation he proposes a width of 88 ft. and a depth of 28 ft. 8 in. He estimates that this would allow two ordinary ships to pass each other. For the river course on the west he plans a width sufficient for the passsage of four ships abreast, but does not give exact dimensions." The cost of the tunnel he estimates as $11,000,000, though he asserts that Chicago contractors have estimated it at $8,000,000; and he places the cost of the completed canal at $48,000,000, which certainly is cheap in comparison with the cost of proposed canals on other routes. Other particulars are given, but the main outlines of the scheme are as stated.

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**Irrigation in Colorado.**

UNDER the title "Colorado as a Grain-Producing State" *Milling* (Feb.) discusses, the progress of irrigation in that State especially, and incidentally the general progress in cultivation by irrigation throughout the arid regions of the west. In Colorado, "within the past few years large tracts of land, otherwise worthless, have been rendered available for farming purposes" by irrigation. By means of canals and ditches "hundreds of thousands of acres are now producing crops calculated to astonish any Mississippi valley farmer. Denver, Longmont, Boulder, Fort Collins, Greeley, and Pueblo have come to be surrounded with productive farms and gardens. The average yield of wheat in Colorado is from 20 to 25 bushels to the acre, but is often 40 bushels and over. This is about double the product obtained in many of the great wheat-growing States."

Our contemporary, after noting the general interest in the subject of irrigation, states that recently "some of the citizens of the western counties in Colorado sent a striking petition to their senator and representatives at Washington. They called attention to the fact that a splendid tract of land, comprising 1,000,000 acres in western Colorado and eastern Utah, is susceptible of irrigation by the waters of the Grand river, and that it would cost about $5 per acre to make this fit for settlement. They urged the government to immediately undertake the reclamation of this immense tract, thus giving employment to a large number of idle men, and making homes for tens of thousands of now landless and homeless families. They pointed out that the government would quickly receive its money back from the settlers, and would thus only temporarily advance the capital required for work. Here are 1,000,000 acres, now desolate and worthless; here is a good river, pouring uselessly to the tropic sea. Marry that water to that land, and lo! the voiceless desert will blossom with the homes of men! The desert of to-day will be the garden of to-morrow, for the soil is rich beyond comparison, and the climate is favorable to an extraordinary degree."

There is a wide and growing field in the great west for engineers expert in the science and art of irrigation. Repairs of engineering works will soon largely supplement new construction, and altogether there is now scarcely a more promising specialty than irrigation in the whole range of civil engineering.

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A CIRCULAR forwarded to us by Mr. John C. Trautwine, Jr., secretary of the Association of Engineering Societies, announces that the Technical Society of the Pacific Coast has recently become a member of the association, making now a total membership of eleven societies. The *Journal of the Association of Engineering Societies* always contains valuable papers, and in the course of a year a wide field of engineering topics is thus covered. A well-prepared monthly index of current engineering literature is a feature.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Civil Engineering in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

### Bridges.

30062. The Proposed Great Suspension Bridge over the Hudson River, New York City. Ill. (Sc A-March 16.) 600 w.

30129. Hudson River Bridge Specifications (E R-March 16.) 3500 w.

30314. Diagram of Comparative Weights of Railway Bridges. Prepared by H. Breen (E N-March 21.) 450 w.

30612. Ballast Floor Bridge, Michigan Central Railroad, Delhi, Mich. Ill. (R R-March 30.) 800 w.

30714. Concrete and Steel Wire Floor, Lincoln Park Bridge, Chicago. Ill. (E N-April 4.) 600 w.

30718. Cofferdams Used at the Queen's Bridge, Melbourne, Australia. (Abstract.) W. R. Rennick (E N-April 4.) 1800 w.

30762. Notes on the Field Inspection of Bridges. Harold Jeans (R G-April 5.) 1600 w.

30763. The New Delaware River Bridge of the Pennsylvania Ill. (R G-April 5.) 1200 w.

### Canals, Rivers and Harbors.

30066. The North Baltic Canal (E & C-March 8.) 800 w.

30104. A New Darien Ship-Canal Route. Ill. Discovered by Gustavus A. Karwiese (E N-March 14.) 700 w.

30108. New Masonry Dam at Lonsdale, R. I.—Combination of Dam and Railway Bridge. Ill. (E N-March 14.) 600 w.

*30259. Manchester Management and Misleading Estimates (Tr-March 8.) 1800 w.

30497. Improvements of the Harbor at Seattle. Ill. (R G-March 29.) 1500 w.

30504. The Canadian Ship Canal Lock at Sault Ste. Marie, Ont. Ill. (E N-March 28.) 3600 w.

30546. The Monongahela River.—Its Importance, Commerce, &c. Ill. (A M & I W-March 29.) 15800 w.

30681. Proposed Steel Lift Locks at Lockport, N. Y., with Editorial. Ill. (Sea-April 4.) 3000 w.

30712. Concerning the Nicaragua Canal and Darien Canal Routes. Editorial (E N-April 4.) 700 w.

30713. Concerning Darien Ship-Canal Routes. Letter from Thomas Wright Hurst (E N-April 4.) 700 w.

### Hydraulics.

30128. The Great Falls, Mont. Water Power. Ill. (E R-March 16.) 1700 w.

*30178. The Drainage of the Haarlem Meer. Ill. Anon. (E-March 8.) 1000 w.

30455.—$1.50. The Halsted Street Lift Bridge. Ill. J. A. L. Waddell, with Discussion (T C E-Jan.) 23800 w.

### Irrigation.

*30147. The Nile. Colin Scott-Moncrieff (N-March 7.) 7500 w.

*30232. Colorado as a Grain-Producing State. Ill. Anon. (Mill-Feb.) 1000 w.

30500. The Santa Ana Irrigation Canal. (Abstract.) William Ham. Hall (R G-March 29.) 1000 w.

*30667. Centrifugal Pumping from Pits in California. Ill. Byron Jackson (I S F-April.) 1500 w.

30700. Riparian Ownership.—Decision of Supreme Court of California (E & C-March 29.) 2200 w.

### Miscellany.

*29320. Masonry Dams. Editorial (Eng L-Feb. 22.) 2500 w.

*29957. How Holland Was Made. Ill. Foster Crowell (C E Mag.-May.) 3000 w.

29976. Recent Highway Work in Vermont (E R-March 9.) 2000 w.

*29984. Tequixquiac Tunnel for the Drainage of Mexico. Anon. (E-March 1.) 3600 w.

30011. Brock Street Tunnel, Montreal. Ill. (C Eng-March.) 1000 w.

30111. The Use of Cheap Local Materials for Improving Country Roads (E N-March 14.) 1200 w.

*30295. Riparian Ownership of Lands Bordering on Lakes and Rivers. J. H. Armstrong (J A E S-Feb.) 3300 w.

*30367. The Blankenberghe Pier, Belgium. Ill. (Eng L-March 15.) 2500 w.

*30374. The Great Tunnels of the World. Robert Jamison (Ch-April.) 4000 w.

*30490. Adulteration of Portland Cements. William C. Hartranft (B B-March.) 900 w.

†30532. Influence of the Size of Grain on the Strength of Cement (I Eng-Feb. 23.) 500 w.

30710. Concrete Well Monolithic Dock Foundations at Newcastle, Eng. (E N-April 4.) 900 w.

30711. The Ransome System of Monolithic Concrete Conduit Construction. Ill. (E N-April 4.) 1300 w.

30736. Measurement of Water. A. M. Ryon (E R-April 6.) 3000 w.

*30748. Maximum Moments and Shears in Trusses Having Parallel Chords by Graphics. Malverd A. Howe (E M-April.) 800 w.

### Serials.

28662. Practical Bridge and Girder Construction. Ill. Anon. (M W-Began Jan. 18—3 parts to date—30 cts. each).

28495. The Blackwall Tunnel. Ill. (E-Began Jan. 4—5 parts to date—30 cts. each).

28498. Thames Bridges. Ill. Anon. (E-Began Jan. 4—7 parts to date—30 cts. each).

30177. Irrigation in Peru. Ill. Anon. (E-Began March 8—2 parts to date—30 cts. each).

*We supply copies of these articles. See introductory.*

# DOMESTIC ENGINEERING

### Sanitary Fixtures and Fixing.

UNDER this title *The British Architect* prints an abstract of a paper recently read by Mr. Paul Gerhardt, dealing with both defective and improved appliances in modern plumbing. There is no waste of eloquence in this article, and only a few of the topics indicative of its scope can be touched upon in this review. The modern practice of architects, in confining plumbing work to kitchen, bath, pantry, and laundry, instead of scattering it all over the house, as was formerly the practice is first commended, and then the author says:

"There is one mistake, however, which is still frequently permitted. This is the placing of the water-closet in the same room where the bath-tub, or the wash-basin, is located. This is objectionable on æsthetic as well as on practical grounds. It is particularly so in the case of the smaller houses, and in apartment houses, with only one bath-room. In more elaborate houses of rich people, where there are several bath-rooms, the separation of the water-closet is not so necessary for practical reasons; but I think that a bath-room with a water-closet can, in all cases, be made much more inviting by contriving an ornamental screen, or a low partition separating the water-closet from the other fixtures. The partition may be lined with marble or tiling, and its upper part may be constructed of open fretwork."

Pan-closets, plunger closets, and valve closets are stated to have gone, or to be going, out of use. Improved water-closet troughs have taken the place of the former privy sink. Wooden laundry tubs have been replaced by better tubs of non-absorbent material. The variety of sanitary fixtures now in market is very large. Among them, Mr. Gerhardt disapproves wash-out closets, though he does not severely condemn them, preferring flush-rim long hoppers, pedestal short hoppers, siphon and siphon-jet closets, or wash-down closets having vigorous and direct flush. Wash-outs are, however, popular at the present time, though this writer does not regard them as the equals of those above named. "Two points require careful attention, where porcelain water-closets are used. One is the floor-joint, which, being on the sewer side of the water-closet trap, must be made tight. The other is the connection between the piping and the earthenware horns of the bowl. If these are made rigid, breakage of the earthenware is the result of the slightest settlement of the floor. A flexible connection is, therefore, much to be preferred, and can now be obtained with many of the types of closets named."

Enameled iron tubs and porcelain tubs are rapidly replacing copper-lined wooden tubs for bath-rooms. The wooden glazed roll rim does away with all need of the undesirable woodwork. Wash-basins include tip-up basins, tie-up basins, chain-and-plug basins, and secret waste-valve basins. Tie-ups and chain-and-plug basins are condemned. The receivers of the tip-ups are stated to get foul, yet credit is given to some modern styles of tip-up basins which are considered as great improvements upon former styles. The open stand-pipe over-flow basin is, for sanitary reasons, preferred by Mr. Gerhardt to any other form now in use; but "the general public is hardly sufficiently educated in sanitary matters to appreciate its merits. By many this form of basin is utterly condemned on account of its odd shape and appearance. The favorite form of basin is just the one which has the most objections from the hygienic standpoint,—namely, the bowl with secret waste-valve." Slop-sinks and house-maids' sinks "are obtainable in a variety of serviceable forms, most of them excellent from the sanitarian's point of view." The avoidance of wood-work at and around plumbing fixtures is a point specially emphasized.

### Greenhouse-Heating.

A. H. DUDLEY, in *Heating and Ventilation* (March 15), refers to the fact that greenhouse-heating is generally a specialty in the heating trade, and he writes with the purpose of enlightening steam and hot-water fitters who have had little or no experience in this sort of heating work. Whether steam or hot water will be the better for any particular greenhouse will depend wholly upon "the conditions under which the plant will be run." The florist who desires to order an apparatus for greenhouse-heating will be likely to have very clear and positive ideas upon this point, and they will be based upon the following considerations. "With steam the temperature of a greenhouse may be quickly raised or lowered, whereas with hot water this takes some time, owing to the larger volume of water in the system. On the other hand, the slowness in lowering the temperature with hot water is often of the greatest value to the florist; for, should the fire go out in the heater during the night, the large volume of water in the system will continue to give off its heat several hours thereafter, thus keeping the plants from being injured by the drop in the temperature which would follow under similar conditions if steam were used. It is also often claimed for hot water that the temperature in a greenhouse may be much better regulated during comparatively mild weather than it can with steam," but with a steam system properly designed temperature may be as easily controlled as with hot water.

Any calculation of heating capacity based upon cubic contents of a greenhouse would be generally faulty in the extreme. The entire equivalent of glass exposure in square feet, including sides, ends, and overhead glass, should be determined carefully, and the "sides and end walls, if of wood sheathed and papered good and tight, should be figured in the following proportion,—*viz.*, 5 sq. ft. of wall to 1 sq. ft. of glass." After getting the number of total square feet of glass and equivalent, the next point is the proper amount of heating surface necessary. This is dependent upon the temperature required, which must be determined by the florist, as the temperatures of greenhouses vary from 35° to 70° F., according to the stock which is to be grown.

The following is given as a safe rule for determining the proportion of heating surface to glass surface for various temperatures in the greenhouse, when the outside temperature is at zero. with no more than 5 lbs. of steam pressure at the boiler. For maintaining a temperature of 40° F. in a greenhouse, 1 sq. ft., of heating surface to every 9 sq. ft. of glass or its equivalent will be needed with steam at the pressure named; and, for each increase of 5° F. to be maintained above 40° F., until 55° F. is reached, the amount of glass for which 1 sq. ft. of heating surface will suffice must be decreased 1 sq. ft.; and thereafter, for every increase of internal temperature of 5° F., the amount of glass for which 1 sq. ft. of glass is sufficient is decreased by 1/2 sq. ft., till a temperature of 70° F. is reached. This rule could not, however, be applicable for all climates, and the author does not give any directions for modifying either for colder localities, or for warmer ones where the Fahrenheit zero of temperature is never reached. The remainder of the article deals with arrangement of pipes and distribution of heat, which topics are illustrated with diagrams, making a good study in modern heating practice for greenhouses and conservatories.

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### A Garden-Sculpture Exhibition.

IT is announced in *Garden and Forest* (March 20) that during the present month (May) there will be held in New York an exhibition of garden-sculpture, the purpose being to stimulate and improve a taste for sculpture in landscape gardening. Mr. N. F. Barrett, landscape engineer, and Mr. Thomas Hastings, of the firm of Carrère and Hastings, architects, have been put in charge of designs for the arrangement of the galleries. The plants needed in their schemes will be supplied by a firm of florists, the underlying idea being to show "the possibilities of combining sculpture with flowers and plants in both natural and formal gardening and interior decorations."

The place where this exhibition will be held will, doubtless, be duly announced in the daily press. We understand that at the time *Garden and Forest* made the announcement a suitable place had not been engaged. The enterprise was initiated and will be carried out under the auspices of the National Sculpture Society, which has issued a circular stating the aims desired and results hoped for. It is the belief—expressed in the circular referred to—that the proposed exhibition will "encourage a larger use of sculpture in the embellishment of the villas and houses of America, and give a new and powerful impulse to the production of ideal sculpture throughout the nation."

There is much doubt whether the exhibition will or can prove successful as an example of effects obtainable in landscape-gardening through the aid of sculpture. Our contemporary speaks of the project as follows: "Fully to display the sculptor's decorative power, formal gardening schemes need great avenues of trees and great stretches of water, giving room for the introduction of stately or graceful figures in symmetrical array, for noble lengths of balustrading, and fountains of monumental size. Nothing of the sort could, of course, be attempted within four walls, even were the vast interior of the Madison Square Garden to be the chosen area, and even did all horticulturists in America contribute of their products. And with regard to naturalistic schemes the case is similar. In such schemes the sculptor can never play a dominant part, as he may in certain portions of formal schemes, and even his part as a docile assistant is rather narrowly limited, and should be played with the greatest care and discretion. Nothing is more certain to injure a naturalistic gardening scheme of broad character than the presence of the smallest piece of sculpture inappropriately placed; and, as the Parc Monceau, in Paris, proves, even Frenchmen have conspicuously sinned in this respect, admirably though they use works of sculpture in more formal pleasure-grounds, like the Luxembourg and the Tuileries gardens. We note with regret that the Sculpture Society's circular speaks of its exhibition as including 'an exhibition of landscape-gardening.' In art, as in everything else, it is important that words be used with precision, lest confusion of thought arise from verbal inaccuracy; and it would be a very confused thought indeed that could picture the interior of an apartment transformed into any scene having a 'landscape' character. Landscape-gardening is one branch of the art; naturalistic gardening on a small scale is another, with quite different ideals to meet, as well as means to employ. No more than the latter branch, on its smallest scale, can be attempted in the coming exhibition, but, even so, right management will be still more difficult than will formal schemes."

The difficulties to be encountered are comprehensively set forth in the quotation. The National Sculpture Society may succeed in organizing a pleasant show of flowers and beautiful sculpture, but that this can include an exhibition of landscape-gardening, as announced in the circular, is clearly impossible.

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### Church-Heating Plants.

THAT a hot-water system of heating is not well adapted to buildings wherein the apparatus is not kept in continuous working from the beginning of cold weather until no longer needed in the spring has long been the contention of those not interested in the manufacture, sale, and erection of such apparatus. The risks to low-pressure steam-heating apparatus through intermittent action are less, but by no means *nil*, as is proved by an extract from an editorial in *The Metal Worker* (March 30), which says: "It is probable that the weather of the past winter made more extensive repairs necessary to church-heating systems than in any others; and whether the systems were steam, hot water, or combination, the effect was the same. The most severe effect of the weather coming at the middle of the week, many church-heating plants were without fire, no fire having been necessary during the previous portion of the season to prevent their freezing. On firing up late in the week for the next

Sunday the damage sustained was discovered, in many cases too late to be repaired in time for use on the following Sunday. In some hot-water jobs every radiator in connection with the plant was frozen and burst, and in some cases every section of the radiator. The damage was not confined to the radiator alone, but both the flow- and return-pipes and the fittings succumbed to the frost. In steam plants where the condensation did not return to the boiler, owing to poor piping or want of air valves, the plants were rendered unfit for service by ice bursting pipes and radiators. In churches where combination apparatus was used some difficulty was encountered in explaining that the water-heating apparatus would be ruined if the furnace was run, though in some cases the risk of its destruction was taken in order to have service. It requires more judgment than is possessed by the average sexton to say when the fire shall be run to prevent freezing, and the extra labor of emptying and filling the system, as a precaution, is seldom undertaken." Low-pressure steam heating, if properly put in, should not endanger steam radiators, whether direct or indirect, although indirect radiators require greater care in setting, and better valves to prevent the accumulation of water in them. If not set so that they will be well drained at all times, the cold air driving in through cold-air ducts is liable to freeze their contents and burst them when they are not in regular use. But care and proper construction of cold-air boxes, with dampers controlled by a thermostat, can be made a safeguard against such accidents. In any system of steam heating, if the water is not drawn off at times when the apparatus is not in use, the return-pipes in the cellar may be frozen at such times—provided the cellar is cold enough for frost—and burst in consequence, as not unfrequently happens.

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### Double-Boiler Plumbing Work.

In many cities—notably in parts of New York city—the hydrostatic pressure due to head is insufficient to supply water to floors higher than the first or second. In such buildings it has been a common practice to pump water up into a tank on the roof, whence it is drawn to supply the floors for which the pressure in the mains is inadequate. A modern method is known as the "double-boiler" system. This system, according to a writer signing himself "Grayson" in the *Sanitary Plumber* (March 15), "is resorted to in all cases for the purpose of avoiding the cost of pumping water to those fixtures which the street-pressure will supply without pumps. When water is pumped to tanks or roofs, the pipes and fixtures connected with the tanks are called the high-pressure system, in contradistinction with pipes and fixtures supplied directly from street mains. There are three general plans of arranging double-boiler jobs. One plan is to place one reservoir within another, and connect only the outside reservoir to the water-back in the range. The high-pressure supply is always connected to the inner reservoir in this style of work, and the water in the inner reservoir is heated by conduction of heat from the water in the space between the inner and outer reservoir walls. By this plan only enough room for one reservoir is required, and there is no cause for having two water-backs in the fire-box of the range, nor a secondary heater without," as is the case with another system described in the article. "In addition to a combination reservoir requiring the minimum of floor space, the cost of one water-back and one set of circulating pipes is saved. Whatever the material of the outside shell of a combination reservoir may be, the inside shell should be of copper.

"The second method of arranging a double-boiler job is to use two reservoirs of substantially the same type as is used in ordinary work, placed side by side, with space enough between them to stand a secondary heater. In this way but one water-back is necessary, as the connections for one reservoir are carried first to the secondary heater and then to the reservoir. The other reservoir is connected to the secondary heater in a manner similar to the ordinary strong connection, and its water absorbs heat from the water which

circulates between the water-back and the other reservoir."

A third variety of double-boiler work is described and illustrated. Its exposition requires the use of a diagram on a scale larger than our columns can accommodate, and the article must be itself consulted by those who desire full information regarding this method. It is not so liable to give trouble as the first method above described.

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**An Unusual Combination Heating System.**

THE above is what *The Metal Worker* (March 30) entitles a description of a heating plant recently installed in St. Andrew's M. E. Church in Brooklyn. It is true that, while this method of heating a church or a school is unusual, it is not new, and, when properly installed, it is so good a system that it is rather surprising that it is not more widely used. The system comprises warm-air furnace heating for mild weather and for ventilation for any weather requiring artificial heat, and a supplementary steam-heating plant, quite insufficient of itself to heat the building, but supplementing the capacity of the furnaces in cold weather. The method seems better in one respect than combination systems wherein steam-generating coils are directly combined with air-heating furnaces, and wherein, when either part of the combination is disabled, neither is available. The method under consideration makes each heating apparatus independent of the other, and hence the term "coöperative" seems to be more appropriate for it than "combination."

There is, however, one objection to this coöperative system. It requires more attention than a single plant of the same capacity. But this does not outweigh its advantages. The installment in the above-named church is a good example of the system. The entire arrangement in detail is described and illustrated in *The Metal Worker's* article. However, an inspection of the plans, as given, compels the belief that a combination of indirect and direct heating by steam would have cost no more than the coöperative system, and that the latter would consume more fuel for the same heating and ventilating effect than the former. But the question of cost is secondary in importance to that of comfort and health.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Domestic Engineering in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

### Heating and Ventilation.

30135. Notes on Steam Heating.—Why Some Plants Fail. Anon. (B J C–March 16.) 1000 w.

30274. Heating and Ventilation of the Nineteenth Ward School. Ill. (H & V–March 15.) 2700 w.

30275. Greenhouse Heating. A. H. Dudley (H & V–March 15.) 1300 w.

30282. The Care of Heating Boilers During the Summer Season. W. H. Wakeman (A M–March 21.) 800 w.

30361. Exhaust Steam Heating. Ill. William J. Baldwin (E R–March 23.) 2800 w.

30520. Practical Suggestions Respecting the Ventilation of Buildings. John H. Kellogg (A A–March 30.) 5500 w.

30524. An Unusual Combination System.—Heating and Ventilation Used at St. Andrew's M. E. Church, Brooklyn (Met W–March 30.) 1000 w.

30741. Heating and Ventilating a Milwaukee School. Ill. (E R–April 6.) 1200 w.

### Landscape Gardening.

30261. Sculpture in Garden Art. Editorial (G & F–March 20.) 2000 w.

†30354. Landscape Gardening. Thomas Hawkes (I A–March.) 3400 w.

### Plumbing and Gas Fitting.

*30025. Sanitary Fixtures and Fixing in Dwelling Houses (Extract.) W. Paul Gerhard (B A–March 1.) 1800 w.

*30208. An Essay on Plumbing. John Troland (Pl D–March.) 2500 w.

30272. Sewer and Drain Connections. Ill. Walter Q. James (S P–March 15.) 1200 w.

30273. The Principles of Double-Boiler Plumbing Work. Ill. Grayson (S P–March 15.) 2000 w.

30744. Lead Pipe Shower Arrangements. Ill. Grayson (S P–April 1.) 1500 w.

### Serials.

29281. Steam Heating as Practiced in the United States. David Nesbit (M S F–Began Feb.—Ended March—2 parts—15 cts. each).

29334. Technical Subjects that Plumbers Should Know. F. Dye (Pl D–Began Feb.—2 parts to date—30 cts. each).

*We supply copies of these articles. See introductory.*

# ELECTRICITY

### Electric Railroads on Highways.

AN important decision recently made by Judge Williams of the supreme court of Pennsylvania affecting the rights of electric railroads on public highways holds that the authorities of a township have no right to subject its highways to a servitude other than for the benefit of the township and the public it represents. The carriage of passengers through the township from one city or borough to another is held to be in no sense a township purpose, and therefore the law does not authorize the grant of a right of way along the public highway of a township for an electric or other railway. This decision seems to indicate the direction which is likely to be taken, in Pennsylvania and some other States, at least, by the contest now going on between the electric and steam railways for suburban and interurban traffic. The *Railroad Gazette* (April 5) devotes considerable space to a discussion of the questions likely to be raised by this decision, and points out that under it the street-railroad companies cannot reach the township property-owner, either through the local authorities or by the right of eminent domain; and hence it is difficult to see how such a company can protect itself in the use of country roads, except by contract with each and every property-owner along the roads which they wish to occupy, and—what adds to the difficulty—these must be dealt with individually, as their rights cannot be taken away by condemnation proceedings. It is, of course, a question how far this view of the law will hereafter be adopted in other States, but a member of the court of errors and appeals of the State of New Jersey, in an interview recently printed in the New York *Evening Post*, expresses the opinion that the decision of Judge Williams would be held applicable in that State. This decision must have the effect of seriously checking the development of interurban electric lines in Pennsylvania, of which a great number have been projected, and some have already been built. No doubt legislation will ultimately be obtained by which the right of eminent domain will be conferred upon this class of railroads, for, in so far as they are a necessary public convenience, they will be built and ought to be built; but, on the other hand, it must be admitted that the effect of the decision, in imposing some check to the current speculative craze for the unnecessary multiplication of electric roads on the public thoroughfares, is by no means a wholly undesirable one.

### Electric-Railway Competition.

THE recent issues of the *Railroad Gazette* contain numerous articles and paragraphs, editorial and otherwise, in reference to the latest developments in the contemporaneous warfare between the steam and electric railroads over short-distance traffic, which in some places has apparently reached what may be termed an acute phase. The new form of competition, as the *Gazette* remarks in an editorial (March 29), exhibits "one characteristic that is very familiar to every railroad officer who has been engaged in many rate-wars, and that is the fact that the aggressive competitors pay very little regard to the true cost of performing the service. Electric roads with new track and equipment can get along for awhile with very little expenditure for repairs, and it appears that in a good many cases the managers base their calculations on the false assumption that the present low percentage of operating expenses can be permanently maintained. They know it is false, but that makes no difference. Again, the favorable attitude of the public may not last, and taxes may be imposed where now everything is free; but that does not worry the man who is industriously engaged in making hay while the sun shines. On the other hand, a street-road so lo-

cated as to do a large short-trip business can afford to carry passengers from village to village very cheaply, and in some cases the steam roads may have to meet three-cent fares instead of five-cent." The legislative hearing in Connecticut a few weeks since, on a measure intended to practically prohibit the granting of electric-railway franchises when in direct competition with those of existing steam lines, brought out some surprising facts as to the losses in local traffic which have been sustained by the New York, New Haven, and Hartford Railroad between certain points on its system, attributable to trolley competition. A large number of these cases represent more than 50 per cent. of the local traffic, and in not a few cases they appear to have practically taken it all. Of course, the total loss is not a large percentage of the entire gross earnings of the trains, but the trouble is that the loss is a dead loss, as the expenses are not diminished a cent, unless the train is discontinued altogether. A correspondent writing from New Haven, in the *Gazette* of April 5, points out that the electric lines have paralleled nearly the entire system of the above-named company between New York and Boston, and states that a summary of the business between points where electric competition exists shows a loss of over $4,000 for each of the winter months. What the steam railroads now ask the legislature to do is to refuse charters to electric lines which parallel the older roads, and especially to restrict the new-comers to city and suburban traffic, and prohibit their cross-country extensions. Says this correspondent: "Electric competition is soon to be a very important factor in passenger traffic on most of our railroads. It seems certain that these new lines will before long begin to do a parcels-express business, and can carry this on with great efficiency. Beyond this it is quite probable that they may eventually carry heavy freight to some extent. With this outlook, how are the steam railroads going to defend themselves? The alternative seems to be before them, either of employing electricity to a large extent on their own lines, and building cheap branches to control the traffic now in the power of these independent roads, or of buying up the electric lines outright, and operating them as an integral part of each railroad system. . . . It is the convenience of the public which must finally decide the question of competition between electric and steam railroads, and it is idle for any one to claim that electric lines shall be confined to the limit of the old horse-car roads in our larger cities."

The opinion was some time since expressed in this department that it is idle for the steam-railway companies to seek to prevent the construction of competing electric lines by restrictive legislation, for, even were this possible, the remedy comes too late. The greater part of the mischief is already done, so far as occupying the territory in dispute is concerned. It was also predicted that the ultimate solution of the problem would be that the trolley lines would come under the control and ownership of the steam lines. If we may believe the current newspapers, it is just this policy that has been decided upon by two of the principal railway companies of the country,—*viz.*, the New York, New Haven, and Hartford, and the Pennsylvania. Moreover, each of these companies has decided to equip one of its branches with electric rolling-stock, the former having selected the Nantasket Beach road near Boston, and the latter the Burlington & Mt. Holly branch in New Jersey, as the scene of its experiments. Both these lines are now being equipped, and will soon be ready for business. A similar project attributed to the New York Central Company for equipping the portion of its line lying along the Niagara river appears to be without substantial foundation, at least as an immediate probability. In spite of the figures presented, it is a question if the managers of the New York, New Haven, and Hartford company are not unnecessarily alarmed. The annual balance-sheet may show that the losses sustained by reason of trolley competition in certain localities have been more than offset by gains in other places due to the same cause. Each system of transportation will ulti-

mately find its own field, in which it can serve the public most economically and efficiently, and this inevitable mutual adjustment is a matter which individuals, legislatures, and courts are alike powerless to prevent.

### A Californian Power-Plant.

ONE of the largest available water-powers in California has been developed by damming the American river at Folsom, and the work, which has been in progress for several years, is now practically completed. The water is to be used primarily for power purposes, and afterwards for the general irrigation of a large tract of adjacent country, it being estimated that some 400,000 acres of land can be brought under cultivation by utilizing the water from the tail-races. More recently, the rapid progress which has been made in the art of electrical power-transmission has caused to be engrafted upon the original scheme a plan for utilizing the 5,000 horse-power available for the purpose to supply electrical energy to Sacramento. The electric plant, now in process of construction, is of the most advanced type, and, when completed, will be scarcely inferior in technical interest to that at Niagara. In the *Electrical Engineer* (Feb. 13) Mr. Geo. H. Guy gives some interesting general particulars of this important undertaking, with illustrations showing some of the prominent features of the hydraulic work. Four three-phase alternating generators of 1000 h. p. each are directly connected to four 1200-h. p. McCormick turbines, running at 350 revolutions per minute under 55 ft. head. Independent turbines of smaller capacity will be employed to operate the exciters. The alternators, now being built by The General Electric Company, are said to be, with the exception of those at Niagara, the largest in the world. They weigh over 40 tons each. The current is to be raised by transformers to a potential of 10,000 volts, and transmitted over a double-pole line, comprising four three-wire circuits of bare No. 0 wire, each circuit having the capacity to deliver 1000 h. p. at Sacramento,—a distance of 24 miles. The local distribution will be at a potential of 100 volts. It is probable that the completion of this plant will solve a good many interesting problems in reference to the commercial aspects of long-distance electric power-transmission.

### Modern Telephonic Apparatus.

THE capacity of the modern speaking telephone for long-distance transmission is mainly due to improvements in the transmitter and in the construction of the connecting lines; the receiving instrument remains substantially the same as when first made known to the public. The *Scientific American* (Feb. 16) has a very fully illustrated article, describing in great detail the construction of the transmitting apparatus now used in this service. There is certainly a wonderful amount of invention and adaptation in this little instrument, and there could be no greater mistake than to suppose, as many do, that the owners of the telephone patents have never made particular efforts to improve their apparatus. Notwithstanding we have been repeatedly informed by the daily newspapers that there were numbers of wonderfully-improved telephones only waiting for the expiration of the Bell patents in order to be placed in the hands of the public, it is a fact that no apparatus has yet appeared which can bear a moment's comparison, in point of effectiveness, with that described in the article referred to. Every detail is the result of long-continued and minute experimentation and research, and the instrument, as a whole, performs its duties in a way that literally leaves no room for improvement.

### Theory and Practice of the Transformer.

THE transformer or converter, as it is variously termed, may be regarded as the emblem of the alternating system of electrical distribution, but to the untechnical mind its nature and functions are an apparently impenetrable mystery. Mr. Caryl D. Haskins, in the *Electrical World* (Feb. 23), in an excellent article, gives a plain and straightforward explanation of the whole matter, showing what a transformer is, what it does, and how and why it does it. The subject is one of no inconsider-

able scientific interest, and the masterly manner in which it has been handled by Mr. Haskins will commend his paper to all who seek information upon the subject of which it treats.

### Electric Line-Construction.

IT is certainly remarkable, in view of the importance of the subject, that there has never been published a solitary treatise of any importance on the subject of electric-line-construction as practised in the United States. Possibly this may have something to do with the admitted fact that most of the line-construction in this country, viewed from an engineering or even from an electrical standpoint, is about as bad as it well can be. The lack of some sort of a standard of good practice for this line of work is apparent at every turn. An article on this subject in *Electrical Engineering* (Feb.) by Alfred Vaughn Abbott, chief engineer of the Chicago Telephone Company, occupying over fifty magazine pages, and profusely illustrated with examples for imitation and warnings for avoidance, will at least do something towards supplying the want, until supplemented by something more exhaustive. Overhead lines for electrical transmission of every kind, including those for electric railways, receive abundant consideration, and there is much of importance and value, not otherwise easily accessible, in reference to underground construction, in which very rapid advances have been made in the United States within the past ten years.

### Central-Station Coal Consumption.

MR. E. A. MERRILL, in a paper in the *Electrical World* (Feb. 23), points out that the most serious problem which confronts the electric station manager is the relation between input and output,—that is to say, between the coal-pile and the switch-board. "When a station is in operation," says Mr. Merrill, "it is far more to the manager's interest to know that his 8 lbs. of coal per kilowatt and per hour cannot be bettered by any similar station than to know that his neighbor in the next town, with a different equipment and service, gets the same output on 6 lbs., and vastly more satisfactory if he knows that his neighbor ought to get the same output on 5 lbs.; a good manager is not one who gets a larger output per pound of coal than his neighbor, but one who gets the largest output possible with his station. Comparisons between stations without discrimination as to equipment or operating conditions are responsible for a great deal of unmerited praise and undeserved adverse criticism." By way of illustration, Mr. Merrill classifies a number of the most common types of central-station plants, and then gives typical sets of curves, graphically showing the relation of different conditions, such as percentage of load referred respectively to the engine and the dynamo, in lbs. of coal per h. p. hour, lbs. of coal per kilowatt-hour, and watt-hours per lb. of coal. The points which Mr. Merrill seeks to emphasize are that stations should not be compared indiscriminately; that comparisons, to be of any value, must have some common basis, and must be comprehensive and accurate; and that there is no better method of checking coal-consumption than by comparisons intelligently made.

### An Electric City.

IF any one city of the United States is more than another entitled to the distinction of being called the "electric," it is a question if that city is not Los Angeles. According to an article by George H. Guy in the *Electrical Engineer* (March 13), the street-railway company distributes some 240 h. p. of electrical energy in small units throughout that city, and the catalogue which Mr. Guy gives of its various applications is no less suggestive than amusing. The principal use of the power is for elevator service and for refrigerating plants. In photo-engraving work two or three large establishments have found that electricity is an ideal power for their purposes, inasmuch as some of their necessary apparatus —for instance, the routing-machine—does its best work at a speed as high as 14,000 revolutions per minute, which is easily obtained by means of a suitable motor. Other uses to which electric power has been applied in Los Angeles are glass-cutting, stamp-cancelling in the post-offi

gem-cutting, optical-grinding, coffee machinery, printing, paint-grinding, boot-blacking, dough-mixing, and so on. Among other matters, a toboggan slide operated by electric motors furnishes amusement to the public. The universal use of electricity for small motors in this particular instance is due in part to the high cost of fuel, and in part apparently to the excellent quality of the service rendered.

### Canal Towage by Electricity.

THE ELECTRICAL ENGINEER (March 13) contains an illustrated description of an electrical apparatus for towing canal-boats which has been for some months in experimental use at Trenton, N. J., and which seems to embody some features of value. A wire rope "cable-way" is placed on brackets upon posts on one or both banks of the canal. An electrical motor is carried upon and operates a "hauler," which runs upon the wire-rope and propels itself by friction independently of its weight. Any existing boat, and, in fact, a string of boats, may be attached to the electric hauler, and pulled along as boats are now by mules, though at a much greater speed and less cost. It would seem as if this ingenious device avoided most of the difficulties found to exist with the trolley system, with which some partially successful attempts have been made on the Erie canal. Certainly the mode of application of the power is much more direct and efficient, and therefore in all probability more economical, than when applied to a propeller by means of a motor carried on the boat.

### Untrustworthy Electric-Lighting Statistics.

SOMETHING like a year ago a table of comparative cost per year of arc-lights in cities owning and operating municipal plants, and in cities supplied by private contract, was published by W. J. Buckley, in his work on "Electric-Lighting Plants" (reviewed in this magazine, Vol. VIII, p. 576). The table was accompanied by a distinct statement that most of the reports from municipal plants included neither interest or depreciation,—two items which represent an average annual outlay of about 13 per cent. on the total cost of the plant. It is obvious, therefore, that any tables which do not include these items cannot give a trustworthy statement of the annual cost per lamp. A prominent real-estate paper of St. Paul, Minn., copied Mr. Buckley's figures as given, without stating its authority and without referring to the all-important qualification given by him. These misleading figures have been widely copied by the newspaper press of the United States, and in many instances have been accepted as authoritative and conclusive. In the *Electrical Engineer* (March 20) Mr. I. C. Wood discusses these figures, and as an illustration compares operations in Buffalo, where a private company receives 35 cts. per night for a nominal 2000-c. p. arc-light all night, with those of the municipal plant in South Norwalk, —referred to in these notes in the March number (p. 1095),—and shows that, although Buffalo pays more than twice as much per lamp as South Norwalk, it gets nearly twice as much light for its money.

### Electric vs. Steam Railroads.

THE Fonda, Johnstown & Gloversville (N. Y.) railroad, a prosperous branch line connecting with the New York Central, was paralleled a year or two since by an electric trolley line. It was remarked in this department at the time that an excellent opportunity would here be afforded to test in actual service the comparative merits of the two systems. Mr. T. C. Frenyear writes to the *Electrical Engineer* (March 20) that the steam road leased its electric rival shortly after its completion, and that the result has been that all the passenger business is now done by the electric road, while the old steam road is used solely for freight. Mr. Frenyear says that experience has shown the greatest advantage of the electric over the steam road to be due to its ability to operate a much greater number of train units at a given cost, the cost per motor car-mile being only about one-sixth the cost per train-mile on the steam road. The motor cars are 36 ft. long, and are provided with baggage, smoking, and ladies' compartments. They have each two

30 h. p. motors, but Mr. Frenyear thinks it would be an improvement to provide 50-h. p. motors wound for high speed, so that on a well-constructed track a speed of 40 m. p. h. might be attained, if necessary, and trail-cars handled when there is an excess of traffic. For a line having different rates of fare, the duplex cash-fare ticket has proved to be the best arrangement. Mr. Frenyear says it is perfectly feasible to operate a 12-mile road from one power house at a pressure of 500 volts, but, outside of city streets, sees no objection to a pressure of 1000 volts. Coming from a person who knows from practical experience what he is talking about, these opinions appear to be of exceptional value as a contribution to the general discussion.

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**Successful Water-Power Plant.**

THE ELECTRICAL ENGINEER (April 3) contains an illustrated description of a device for governing water-wheels, which incidentally gives a great deal of interesting information about the power-transmission plant at Baltic, Conn., from which the Ponemah mills at Taftville and the street-railway system of the city of Norwich are supplied with power. This was one of the first three-phase plants installed in this country, and some particulars respecting it were given in this magazine last year (Vol. VII, p. 413). Until recently the excessive variations in the load have caused a great deal of trouble in the regulation of the machinery at the power-station, which, it appears, has now been in a great measure obviated. An instructive graphic diagram, showing the concurrent variations of speed and load, adds much to the interest of the article. It is stated that the use of this plant saves in cost of coal from $40 to $50 per day the year round. The distance through which the power is transmitted is 4½ miles, and the loss between generator and motor pulleys is found to average about 18 per cent., varying of course according to the load.

The *Electrical World* (March 30) publishes an abstract of a letter written by E. F. Carpenter, superintendent of the three-phase electric plant at Concord, N. H., heretofore referred to in this magazine (Vol. VII, p. 257), which has been in operation since September, 1893. He speaks very highly of the operation of this pioneer plant. There are now over 400 h. p. in motors and over 6000 incandescent lamps in operation from two 250-k. w. generators. The length of line is 4 miles, the voltage at the point of distribution being 2200 on the primary and 110 on the secondaries. The loss between the generators and transformers is 7½ per cent. under the heaviest load yet carried. The motors start promptly under load, and their variation in speed between load and no load is less than 2 per cent. Motors and lights are run from the same transformers. No difficulty is experienced in balancing the circuits; a difference in load of 25 per cent. between two sides occasions no inconvenience. A great deal of heating and cooking apparatus is in use, and the use for domestic service is rapidly increasing.

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CANADIAN ELECTRICAL NEWS says that the town of St. Louis Du Mile End has entered into a contract with the Citizens' Light & Power Co., to light the streets of the town, and has also entered action against the Montreal Street Railway Company for laying their track within the limits of the municipality. The company claim that they were obliged by the city by-laws to lay down the tracks, and will hold the city of Montreal responsible for any damages which may be incurred.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Electricity in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

### Lighting.

*29961. The Illumination of Streets by Electricity. Ill. Franklin Leonard Pope (E Mag-May.) 3000 w.

30054. Elihu Thomson on the Patent Situation Resulting from the Bate Decision (E R N Y-March 13.) 1200 w.

30094. Signaling Weather Predictions by Searchlight. Ill. (W E-March 16.) 1000 w.

*We supply copies of these articles. See introductory.*

30112. The Candle-Power of Arc Lamps. Editorial (E N-March 14.) 2000 w.

*30204. The Cause of the St. Pancras Explosions. Editorial (E R L-March 8.) 1800 w.

*30205. The Dangers of Underground Mains (E P-March.) 1700 w.

30278. Electric Lighting Statistics. I. C. Wood (E E N Y-March 20.) 1200 w.

30328. Electric Lighting. E. A. Claremont (A & B-March 23 ) 6400 w.

*30409. New Alternating Current Arc Lamp. Ill. Abstracted from Elektrotechnische Zeitschrift (E E L-March 15.) 650 w.

30433. The Logansport Municipal Lighting Plant, Combining Water and Steam Power. Ill. Carl Kammeyer (E E N Y-March 27.) 2000 w.

30461. The Blackening of Incandescent Lamps. G. Tolomei (E W-March 30.) 1100 w.

30473. Nikola Tesla and the Electric Light of the Future. Walter T. Stephenson, in The Outlook (Sc A S-March 30.) 2700 w.

30673. A Combined Electric Lighting and Water Works Plant.—St. Lazarus. Described by Max Luhn (E W-April 6.) 1400 w.

30675. Influence of Carbons on the Candle Power of the Arc Light. Wilbur M. Stine (E W-April 6.) 1200 w.

### Power.

29980. Power Required for Elevators. Ill. Thomas J. Fay (E A-March 9.) 600 w.

*29996. The Practical Application of Alternating Current Motors. Ill. Walter J. Fryer (E E L-March 1.) 3500 w.

30068. The Lamb Electric Cable Way for Canal Boat Haulage. Ill. Anon. (E E N Y-March 13.) 1300 w.

30089. Power Transmission. Ossian Chytraeus (E W-March 16.) 1100 w.

30133. Niagara Falls Power. Anon. (F W-March 16.) 1600 w.

*30183. Short Air-Space Dynamos. Editorial (E-March 8.) 3900 w.

*30190. The Utilization of Niagara. Ill. Ed. C. DeSegundo (Eng L-March 8.) 4400 w.

†30194. A Method for Preventing Armature Reaction. Ill. Harris J. Ryan and Milton E. Thompson (T A I E E-March.) 5000 w.

*30203. Note on Electric Percussive Drills. Ill. Albion T. Snell (El-March 8.) 1100 w.

30267. Professor George Forbes on Niagara and Its Critics (E R N Y-March 20.) 1300 w.

30277. The Improved Ball Automatic Dynamo. Ill. Frank H. Widmayer (E E N Y-March 20.) 1200 w.

*30411. Electrical Transmission of Power in Shipyards and on Board Merchant Steamers. (Abstract.) Ill. W. Carlisle Wallace (E E L-March 15.) 2800 w.

30468. The Electric Transmission of Energy. Editorial (Sc A-March 30.) 800 w.

30752. Electrical Transmission of Power from Folsom, Cal. Ill. (W E-April 6.) 1800 w.

### Telephony and Telegraphy.

30055. Telephone Service in Europe and America From Remarks of Gen. Benjamin F. Tracy (E R N Y-March 13.) 2000 w.

30064. The Theatrophone. Ill. (Sc A S-March 16.) 2300 w.

30168. Telephone Companies vs. Electric Street Railway Companies. George D. Fisher (S R G-March 16.) 1400 w.

30268. The Telephone Situation in a Nut-Shell. Editorial (E R N Y-March 20.) 1300 w.

30436. The Jacques Long Distance Vibrating Microphone. Ill. (E E N Y-March 27.) 1100 w.

30437. The Walter Combination Fire Alarm and Police Signal System. Ill. (E E N Y-March 27.) 2100 w.

30439. The Telephone Controversy in New York State.—A Summary of an Interesting Legislative Contest (E R N Y-March 27.) 1800 w.

30684. The Amstutz Electro-Artograph. Ill. (Sc A-April 6.) 1500 w.

30747. The Storage Battery in Telegraph Offices. Ill. William Finn. From the Telegraph Age (E A-April 6.) 700 w.

30823. The Interior Block System of Telephone Wiring. Ill. (E R N Y-April 10.) 500 w.

### Miscellany.

29442. The Electrical Transformer. Ill. Caryl D. Haskins (E W-Feb. 23.) 3400 w.

*29964. The Modern Science of Electric Heating. W. S. Hadaway, Jr. (E Mag-May.) 3000 w.

*29987. The Propagation of Magnetism in Iron. Editorial (E-March 1.) 1800 w.

*29997. On a Proposed Modification of the Generally Accepted Temperature Co-efficient of Resistance for Copper Wires. A. E. Kennelly and Reginald A. Fessenden (E R L-March 1.) 300 w.

*29998. Atmospheric Electricity. (Abstract.) Ill. Professor Schuster (E R L-March.) 1900 w.

30056. Explosions in Underground Electric Mains and Suggestions How to Prevent Them. Arthur Shippey (E R N Y-March 13.) 1000 w.

30059. A Method of Determining the Eddy Current and Hysteresis Losses in Direct Current Armatures. A. W. K. Pierce (E N Y-March 13.) 1500 w.

30090. Electricity Direct from Fuel. C. J. Reed (E W-March 16.) 1800 w.

30142. Kelvin's Law of Economy in Conductors. Frederick A. C. Perrine (E E-March.) 1900 w.

*30172. Sodium and the St. Pancras Explosions (B-March 9.) 1200 w.

†30195. Continued Discussion of H. Ward Leonard's paper, "Notes on Recent Electrical Engineering Development in France and England" (T A I E E-March.) 8300 w.

30269. Egypt Welcomes Electricity. V. M. Berthold (E R N Y-March 20.) 600 w.

30270. To Make Safes Burglar-Proof by Electricity. G. P. Hachenberg (E R N Y-March 20.) 900 w.

30271. The Study of Atmospheric Electricity at Sea. W. F. Magie (E R N Y-March 20.) 900 w.

30291. Wires in Boston All Going Under Ground. J. C. Edgerly (W E-March 23.) 1600 w.

†30302. New Theories as to the Nature of Electricity (S In-Jan.) 3000 w.

30303. Electrical Type-Setting Machine. Ill. Invention of Father Calendoli (E W-March 23.) 500 w.

30304. Electrical Engineering at Purdue University. Ill. (E W-March 23.) 1200 w.

*30383. The Lethal Effects of Electrical Currents. H. Lewis Jones (E R L-March 15.) 2700 w.

*30385. Law Relative to Conductors of Electric Energy in France (E R L-March 15.) 700 w.

*30387. On Professor Nipher's Views on Capacity. Silvanus P. Thompson (El-March 15.) 1500 w.

30406.—75 cts. An Apparatus for Measuring Difference of Phase between Alternating Currents. Ill. Louis Derr (T Q-Oct., 1894.) 1200 w.

*30410. The Scientific Foundations of Electrical Engineering. F. G. Baily (E E L-March 15.) 2500 w.

30435. Covered Fuse Cut-Outs Dangerous. Walter E. Harrington (E E N Y-March 27.) 500 w.

30462. Microscopical Research on the Electrostatic Discharge. Ill. George T. Hanchett (E W-March 30.) 2400 w.

†30495. Tesla's Oscillator and Other Inventions.—An Authoritative Account of Some of His Recent Electrical Work. Ill. Thomas Commerford Martin (C M-April.) 8000 w.

†30548. The Velocity of Electric Waves. John Trowbridge and William Duane (A J S-April.) 3300 w.

*30640. Electric Currents of High Pressure and Periodicity. Ill. A. A. C. Swinton (E E L-March 22.) 3300 w.

30649. Nikola Tesla's Lost Apparatus. Ill. (E R N Y-April 3.) 2000 w.

30650. Tests of the Gülcher Thermo-electric Battery. Ill. (Translated.) J. S. S. (E R N Y-April 3.) 800 w.

30672. Electricity in the New York Navy Yard. Ill. (E W-April 6.) 800 w.

30797. Some Faults in the Operation of Electric Plants. C. E. Woods (E I-April.) 2200 w.

30805. Notes on the Electrostatic and Magnetic Circuit Analogy. J. E. Taylor (E R L-March 29.) 3000 w.

### Serials.

22059. Practical Notes on Dynamo Calculation. Alfred E. Wiener (E W-Began May 19, 1894—33 parts to date—15 cts each).

23866. Electrodynamic Machinery. Ill. Edwin J. Houston and A. E. Kennelly (E W-Began July 21—30 parts to date—15 cts. each).

24536. Principles of Dynamo Design. Newton Harrison (E A-Began Aug. 25—24 parts to date—15 cts. each).

25895. The Design and Specification of Electric Lighting Works for Architects and Civil Engineers. Howard Pentland and Alfred H. Gibbings (E L-Began Oct. 5—26 parts to date—30 cts. each).

25907. The Alternating Current; Its Generation and Distribution (E I-Began Oct.—5 parts to date—15 cts. each).

26952. Electrical Power Transmission. Louis Bell (E W-Began Nov. 10—19 parts to date—15 cts. each).

27371. The Electric Light. Henry Stooke (I C B-Began Nov. 23—19 parts to date—30 cts. each).

27704. Some Hints on the Building of Electric Plants. Ill. Charles G. Armstrong (E I-Began Dec.—Ended April—5 parts—15 cts. each).

28759. The Electric Arc. Hertha Ayrton (El-Began Jan. 18—6 parts to date—30 cts. each).

29041. Recent Progress in Electrical Engineering. S. Flood Page (E Rev-Began Jan. 21—2 parts to date—30 cts. each).

29156. Technical Telegraphy Papers. James Bell and S. Wilson (E L-Began Feb. 1—9 parts to date—30 cts. each).

29158. The Construction and Use of Electrical Measuring Instruments. Charles H. Yeaman (E L-Began Feb. 1—9 parts to date—30 cts. each).

29159. Notes on Search Lights. Ill. J. Watts (E L-Began Feb. 1—5 parts to date—30 cts. each).

29798. On Slow Changes in the Magnetic Permeability of Iron. Ill. William M. Mordey (E R L-Began Feb. 22—Ended March 1—2 parts—30 cts. each).

29329. Propagation of Magnetization of Iron as Affected by the Electric Currents in the Iron. Ill. J. Hopkinson (El-Began Feb. 22—Ended March 1—2 parts—30 cts. each).

30305. Electrical Condition of Buried Conductors Due to Leakage Currents from Electric Railways. W. Stuart-Smith (E W-Began March 23—3 parts to date—15 cts. each).

30674 Gas Batteries. C. J. Reed (E W-Began April 6—1 part to date—15 cts).

30696. Electric Power Transmission. Ill. T. H. Leggett. From Tr. A. M. E. (M S P-Began March 30—1 part to date—15 cts).

30699. Operating Machine Tools by Electricity. Ill. George Richmond (I E-Began March 2—1 part to date—45 cts.)

30806. Alternate Current Motors. Ill. W. G. Rhodes (E R L-Began March 29—1 part to date—30 cts).

*We supply copies of these articles. See introductory*

# INDUSTRIAL SOCIOLOGY

### The Relief Department of the Pennsylvania Railroad.

THE Pennsylvania Railroad is truly a great corporation. Its greatness does not consist alone in its enormous capital, the extent of its operations, the excellence of its entire outfit, and the magnitude of its traffic. Its management, in marked contrast with that of many other railroads, is progressive, and comprehensively grasps everything—even to the welfare of its employees—that is necessary to the permanent prosperity of its interests. What a great corporation can do, and what this one is now doing, to benefit its labor element is shown in a report of its Relief Department, recently issued. *The Railroad Gazette* (March 15) editorially reviews the report, justly regarding it as a "remarkable document showing the magnitude and success of this department, which may be termed a departure from ordinary business methods." It is, however, regarded as "a departure the character of which is coming to be recognized as strictly consonant with the best business principles, although in its inception the Pennsylvania officers were largely actuated, no doubt, by philanthropic motives." Perhaps we shall be forced to admit that some corporations have souls. We abstract *The Railroad Gazette's* summary of the report. Among the discordant notes of discontent now ringing throughout the land it is encouraging and restful.

"This department was inaugurated in 1883, and provides for contributors, at a moderate cost, certain allowances or 'benefits' when they are sick or suffering from accident, and certain payments to their families or designated beneficiaries when they die. Membership is voluntary, and the number has grown from 19,952 at the close of 1886 to 33,405 on December 31, 1894. The latter number comprises more than half the employees, many of the remainder being ineligible on account of age or physical condition.

"The surplus now amounts to $273,751, but it is still insufficient for establishing a superannuation fund on a firm basis. The subject, however, is receiving the earnest attention of the advisory committee and of Superintendent Anderson. The death rate during the year was equal to 11.5 per thousand members, and the average number constantly disabled was equal to 32.3 per thousand.

"Simultaneously with the report, the company has issued a pamphlet describing the department, and stating in a plain way the results of the past 9 years. The sums shown to have been received and paid out strike the reader as something enormous. The revenue of the relief fund is stated as $4,949,011. In the distribution of this in benefits, men disabled by accident have received $722,565. To the sick has been paid $1,287,220, and the death benefits have amounted to $420,944 for accident cases and $1,279,215 for death from other causes; the total benefits amount to 3,709,945.

"The financial statement shows that there is on hand $195,935, subject to payments of liabilities, and that there is a separate surplus fund of $273,751, which has been set aside as a basis for a superannuation fund which it is intended to establish.

"No operating expenses are paid from the fund, all these being paid by the company, which also supplies office and transportation facilities. The actual cash paid by the company for operating during 9 years is stated at $636,555, in addition to $136,645 paid by the company through the Relief Department for aid to its members who remained sick after exhausting their title to benefits under the regulations governing the relief fund. The total payment for sickness has been nearly double the amount paid on account of accidents; and the amounts paid for death from ordinary causes have been over three times as great as those paid for death from ac-

cident in the service. To show the moderate cost of membership in this association, it is stated that a member may draw for sickness, in one year, as much as his dues would aggregate in 16 years, and that the death benefit is equal to the dues of 28 years; and the safety of the insurance is practically guaranteed by the Pennsylvania Railroad Company, with its $129,000,000 of capital. The Employees' Savings Fund, which is entirely distinct from the Relief Association, now has 4112 depositors. The amount received during 1894 was $366,015, and the amount of money in the fund $1,354,595." Such a policy as this toward employees shows an intelligent recognition of the main principle upon which society is based,—the mutual interdependence of all its elements, irrespective of class or station. It is an example which, we hope, will find numerous imitators.

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**The Real "Quintessence of Socialism."**

THAT part of this title of a paper by W. H. Mallock (*The Forum* for April) which is marked by quotations is the name of a recent German treatise written by Dr. Schäffle. The two words prefixed (The Real) are Mr. Mallock's. This might mean that the latter thinks Dr. Schäffle has really perceived and described this quintessence, or that he has failed in the analysis, and that his commentator proposes to point out such failure. We see that the latter is the purpose when a little way on Mr. Mallock asserts in substance that, while what Dr. Schäffle has written is interesting, the book is more interesting on account of what its author omitted to write than on account of what he has actually written.

He (Dr. Schäffle) is, "let it be remembered, a man who, in a certain sense, speaks on the subject with an exceptional, if not unique, authority. He has devoted to the study of Socialism many years of his life. He is a complete master of its literature, or at all events the most important part of it. He has had every opportunity of observing the character and the aims of its leaders in the country where, both intellectually and practically, it has reached its highest development; and, although he has approached it as a critic rather than as a convert, he is a critic who has sought to discover its essential strength, not to discredit it by obtruding its accidental weaknesses." As to the "numerous and conflicting developments" of Socialism, it is conceded that the view expressed by Dr. Schäffle, that "whatever absurdity may be found in such developments," the "ideas and doctrines from which they spring are not absurd in themselves" is just. "They may be wrong, or right, or partly one and partly the other; but, if wrong, they are wrong in a grave and reasonable way; and they offer us a *prima facie* case for grave and careful examination. They cannot be disposed of by a laugh or a facile sarcasm."

It is further admitted that Dr. Schäffle has shown "the more extreme doctrines of the Socialists, the doctrines which appeal most easily to the imagination of the ordinary public, to have no connection with the essence of Socialism whatever." "He shows, for instance, that the position of Socialism with regard to private property is very different from the idea popularly formed of it; and that it does not of necessity tend to deprive the individual of his house, of his chattels, of an adequate private income, of freedom to spend it, of a limited freedom to save it, and even of a limited freedom to bequeath his savings to others. The whole essence of Socialism, or, as Dr. Schäffle calls it, the 'quintessence,' he shows to be comprised in the doctrine that society should, as a whole, acquire possession, not of all private property, but of a specific part only and that part is not income, but capital,—not the products, but merely the means of production. The Socialistic revolution carrried to its logical conclusion would merely turn the whole community into a single manufacturing and trading company, in which each citizen would be a wage-earner or salaried employee. No citizen would be allowed individually to own any of the means either of manufacture or exchange any more than an English officer to-day is allowed to become a shareholder in Gibraltar or in Portsmouth dock-yard.

But every citizen would be allowed to spend his salary as freely as an English officer does now, and to save it as freely. There would be this difference only: his savings would bear no interest; they would virtually be put into a stocking." But Dr. Schäffle's criticisms of this doctrine are pronounced "minute, tentative, timid, almost apologetic." However, he reaches the conclusion that, as "the efficacy of all collective labor depends on the manner in which it is directed and controlled, and as, were a whole nation converted into a single firm which manufactured and distributed everything and had to find remunerative employment for every one, the business of direction would not only be as important as it is now, but incalculably more difficult," it would be "very doubtful whether a Socialistic State would be able to find men capable of undertaking it." Mr. Mallock styles these but "so many incomplete and feeble ways of expressing the single great underlying fact which has made Socialism impossible ever since the beginning of the world, and which stands in the way of its ever being possible in the future."

This exposition of Socialism shows it to be radically different from the thing that many—perhaps most—people suppose it to be; but Mr. Mallock contends that "the proposal to substitute the State for the private employer or capitalist," so far from being the "quintessence" of Socialism, is merely the shell of a kernel, which kernel "is the proposal to reduce to an indefinite degree—indeed, practically to extinguish—the existing motive to the exercise of certain exceptional powers, which, in a Socialistic State, would be just as essential as at present, and yet to secure their exercise in all their present intensity." Of course, by "exceptional powers" is meant the ability to direct and manage a large enterprise.

"A man at present toils night and day in creating or directing some great industry, and as a reward has a palace, a picture gallery, and a yacht. Were the State suddenly Socialized, this man—or some one exactly like him—would be continued in precisely his present position and authority and asked to perform exactly the same functions. The only difference would be that his palace and his yacht would be taken from him, and his utmost hopes cut down to a six-roomed villa, which would differ very little, as Dr. Schäffle informs us, from the house of the stupidest and least efficient of the laborers whose labor, but for himself, would hardly be worth anything. This is the difference from the existing system, which is really the quintessence of Socialism; and the fundamental question on which the practicability of Socialism turns is simply this question of whether able men as a class would continue to develop and exert their faculties as they do now when nearly all the motives which cause their activity now, and which have caused it since the beginning of civilization, are carefully and deliberately, if not vindictively, annihilated."

The question here asked is not definitely answered by Mr. Mallock, but he maintains that it is "crucial," and that the entire argument criticised rests on and flows from a failure, like Dr. Schäffle's, to push the analysis of the Socialistic problem far enough, and to see that the classes of men with which Socialism professes to deal are divided, not only by the accidental fact that some men possess capital and some do not, but by the fact that some possess exceptional faculties and some do not, and that the former are just as essential to the success of Socialism as the latter. It is further asserted that the history of Socialism has shown that it does not draw into its ranks, "and does not possess in its own fold at present, men capable of directing the productive work of the world," and "that it is forbidden by its own principles to offer the only rewards that will enlist such men in its service."

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**The Federal Department of Labor.**

IN an interview with the Hon. Carroll D. Wright, by Herbert Johnston, published in *The Chautauquan* for April, an account of the organization of labor bureaus is given. There existed nothing of the kind 27 years ago,—"no regularly organized department under any government in the world, equipped and authorized to investigate systematically work, wages, and the

social conditions of working people. It was purely an American idea which conceived the plan of bringing the functions of government to bear on this special field of social inquiry, and it found application first in the State of Massachusetts, when in 1869 the original bureau of statistics of labor was established."

The Massachusetts bureau of labor is credited, from the outset up to the present time, with important results. The example was soon widely followed. "To-day thirty-two American States employ this method in a variety of forms, while the federal government, through its department of labor, carries on independent investigations by the statistical method which those of the separate commonwealths admirably supplement. Nor has the American idea found acceptance in its native land alone. Seven of the foremost nations of Europe—England, France, Belgium, Germany, Russia, Austria, and Sweden—have institutions similar to our bureaus of labor statistics, their work being conducted as best suits the character and policy of their different governmental systems." Four years after the organization of this bureau, Mr. Wright was appointed its chief. Under an act approved in June, 1884, the United States bureau of labor was organized in 1885, and Mr. Wright was appointed its chief by President Arthur, who desired the bureau to be "conducted on the lines of the Massachusetts office." Mr. Wright has been retained in the office ever since, resigning a lucrative legal practice for the meager remuneration he now receives. He tells the interviewer how he has been desired by both Republican and Democratic organizations to remain in his present position. "When President Cleveland came in, I promptly tendered my resignation to Mr. Lamar, secretary of the interior, who informed me that he did not wish to accept it. In June, 1888, congress changed the bureau of labor in the department of the interior to an independent department under the title of the department of labor. This act creating the department of labor provided for a commissioner of labor, the same as the act creating the bureau which preceded it. In February, 1889, Cleveland gave me an appointment under the law, which appointment was renewed by President Harrison in 1893, and I am now serving under his commission." Mr. Wright states that the classified list of persons "annually engaged in the work of the federal department of labor" comprises "seventy-six people, of whom twenty are special agents who devote their whole time to field work. Beyond this number seventy-six, we generally employ, under special appropriation and under our miscellaneous fund, temporary experts and employees as the contingencies of the office arise. So that on the average I suppose we employ about one hundred people constantly. Sometimes we have as high as one hundred and twenty." The average annual appropriation for the work of the bureau is $175,000, exclusive of the cost of printing reports. As to the "chief practical value of such a department to the government and to the people," the commissioner says: "I have always considered the work of the department of labor as part of the educational work of the country,—that it is absurd to expect it to secure any immediate material benefit to any individual or body of individuals. The work of the department bureau of statistics of labor has, however, accomplished direct results in several directions. It has secured some very excellent legislation, and it has prevented some very vicious legislation. It helps to remove apprehensions and to correct false ideas. It puts into scientific classified form the nebulous information of the people. Through the investigations there has come into existence factory inspection and the guarding of machinery to prevent accidents, modifications of the employers' liability rule of common law, and other things which I might mention. But its chief value to my own mind is that of one of the features of the educational forces controlled by the government. Of its value to the government too much cannot be said. The department of labor is constantly employed in furnishing the press, the legislators, students, and teachers, collected information, without which they would have been obliged to deal with unknown quantities."

**The Meaning and Measure of "Unemployment."**

VERY much has been recently written and said about the vast numbers in commercial centers and manufacturing towns who are out of employment. Regarding it "as perhaps the most illusive term which confronts the student of modern industrial society—a term that gives rise to much unwarranted exaggeration," and adopting the view of Mr. Charles Booth, who urges that "the total number of the superfluous is the true measure of the unemployed," Mr. John A. Hobson makes an effort in *The Contemporary Review* to reach the true meaning and measure of the term "unemployed."

The idle time of those workers who from choice work 4 or 5 days per week at their trades rather than distribute their labor through the entire week cannot properly be called "unemployment" in an economic sense; but, if short time is forced upon employees in any way and in opposition to their wishes, the off-time must be so ranked. Neither can what the author styles "leakage," such as the intervals between jobs in the building trades, etc., be ranked as unemployment.

"A census of the unemployed, taken on a given day, would be apt to include a certain number of masons, bricklayers, &c., who were at leisure for this season. Yet, so far as this leakage belongs to an irregularity inherent in the trade, it cannot rank as waste, nor could the labor thus temporarily displaced be regarded as 'superfluous.' But a strict limit must be assigned to this 'necessary' leakage. If the building trade is slack, not only will a smaller number of workers be employed, but the intervals between jobs will be longer. Here there exists a genuine waste of labor-power, which would rightly rank as unemployment. A period of brisk trade in which intervals are smallest must be taken as the right measure of necessary leakage, and even then, if the leakage is due to inadequate organization in the trade, it implies some waste. In various trades improved intelligence, cheaper travelling, travelling benefits of trade unions, have reduced what would formerly have been considered necessary leakage due to natural conditions of the trade."

But seasonal fluctuations or "leakage" ought not to be assigned for the large measure of unemployment which has recently existed in nearly all lands, and the report of the British labor department, which assigns seasonal fluctuations as largely influential in causing it, is severely criticised as begging "the entire question with almost humorous effrontery." "As an alternative to the suggestion that without this unhappy margin of waiters there would not be enough men to execute the work when trade revived, I would put the following question: May not the existence under normal conditions of an average margin of 5 per cent. unemployed in the skilled trades, and possibly a larger margin in the unskilled trades, be a cause, as it is certainly a condition, of the very fluctuations which make this year good and that year bad?" If there did not exist this margin, it is evident trade could not revive to the extent it does in such a year as 1889; but, on the other hand, is it not conceivable that it might not so deeply as in 1887? In other words, is it not possible that the fluctuations would be less violent, if there did not, under normal conditions, exist an average reserve force of labor to play with?

This question is raised in "protest" against the placid assumption in the Unemployed Report that there is no "superfluity of labor, because the superfluity is sometimes for a brief period mopped up." It is also maintained that unemployment has been greater among unionists than among union members, and that it is greater among unskilled than among skilled workmen. Some startling figures are given anent what are styled the "high-class unemployed" in England, by which is meant, not the large number of professional men who fail to get sufficient business, but those who do not desire employment, living as non-producers entirely upon the produce of others' labor. These are styled "able-bodied adult paupers," and it is stated that "in England and Wales alone" on the first day of the present year there were 116,478 of this class.

The fact that in times of depression a large number of those who are thrown out of employment are found to have some individual vice or defect does not justify the charge that their unemployment is due to this cause alone. This is only one of many causes. Many who are retained in employment have the same vices and defects, and those thrown out are re-employed when trade revives again.

"Unemployment of labor, waste of labor-power, does not stand alone. At the great periods of depression we have not only unemployed labor, but unemployed capital. Nor can it be accounted a mal-adjustment of capital and labor as between trade and trade. The special characteristic of industry during a period of trade depression is that, not in this or that trade, but over the general field of industry, there is labor-power and capital lying unemployed. The actual phenomenon is a general excess of productive power. The waste of labor power in our modern communities is evidently but one important aspect of an even larger economic problem."

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### New Trade-Unionism.

THE newer phases of trade-unionism in England are made the target of a very caustic criticism in the *Journal of Gas Lighting* (Feb. 12), under the caption "New Unionism Reviewed." The article is in the nature of a review of "Methods of the New Trade-Unionism" printed in the *Quarterly Review* for February, which is characterized as "more than a mere recapitulation of the outrages committed by, or in the presumed interest of, members of the new trade unions, and more than a record of the wild counsels given to infuriated mobs by men who are now members of parliament, county councillors, guardians of the poor, and so forth. It serves the purposes both of a chronicle and a criticism, inasmuch as, together with the record of what has been done in the name of trade-unionism of the new variety, it gives a survey of the writings and other influences of the times which have been more or less patently instrumental in rendering such things possible, even inevitable." Five books were named in the *Quarterly Review* as having contributed notably to current opinion on trade-unionism,—namely, "Essai sur la Répartition des Richesses," par Paul Leroy-Beaulieu (3me édition; Paris, 1888); "Le Collectivisme—Examen Critique," par Paul Leroy-Beaulieu (3me edition; Paris, 1893); "A History of Trade-Unionism," by Sidney and Beatrice Webb (London, 1894); "A Criticism of the Theory of Trades Unions," by T. S. Cree (third edition; Glasgow, 1892); "Trade-Unionism—A Criticism and a Warning," by James Birks. Of this list the *Journal of Gas Lighting* says: "This is not a long list; but it must occur to the reader that it probably represents far more systematic study than could be credited to most of the turbulent persons whose doings point the moral and adorn the tale of the reviewer. If it is necessary to read five books of what the ordinary frequenters of public free libraries in this country would designate as a 'dry' order, before one can understand anything about the true inwardness of the doings of the new trade-unionists, how many books were required to be read by the doers thereof? The answer is, obviously, none; and it puts in the most glaring light the reason for the men who know all about the why and the wherefore of popular movements not being the leaders of these manifestations, but being aloof in libraries and studies, whence their belated utterances hardly reach the crowd without. The men who figure in popular commotions do not know; the men who know do not act. And so it comes about that the largest portion of that popular passion which, if only properly directed, might move the world is spent against immovable obstacles deep-rooted in the scheme of things, but not discovered by the blind zeal of the agitator. 'Come, let us make all things new,' cries the demagogue; and he helps to create a new variety of trade-unionism to start with. For a time the organism seems charged with a lusty life, and of a strength to beat down all opposition. Nothing, or hardly anything, stands against it; only a stubborn individual here and there will not bend, only an insignificant old law or two fails to

sanction the new movement. What are such obstacles to the freshet of popular frenzy? Will they not be uprooted, swept away, demolished? Nothing of the kind. They stand their ground; and in a very brief period it is seen that, while they remain, it is the popular force that has become spent. Then from his old observatory comes the calm remark of the student: 'I told you so.' It seems a pity that he could not have been heard before."

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THE Leicester, England, workmen in the building trades in recent trade disputes declined arbitration. The *British Architect* says that the spring of 1895 will be memorable for poverty and distress amongst a class who ought not to suffer it.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Industrial Sociology in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

†30014. The Referendum in Switzerland. Numa Droz (C R-March.) 7800 w.

†30015. The Manchester School. Goldwin Smith (C R-March.) 5800 w.

†30016. The Meaning and Measure of "Unemployment." John A. Hobson (C R-March.) 7800 w.

†30042. On Some Legal Disabilities of Trade Unions. Bernard Holland, with Prefatory Note by the Duke of Devonshire (N C-March.) 7800 w.

†30247. Mr. Morley and the Irish Land Bill. T. W. Russell (F R-March.) 8000 w.

†30248. Politics and the Poor Law. T. Mackay (F R-March.) 6500 w.

†30249. The Crisis in Newfoundland. William Greswell (F R-March.) 3600 w.

*30260. The Labor Agitator and London Docks (Tr-March 8.) 1900 w.

*30344. Conciliation (Trade Disputes) Bill. Editorial (E-March 15.) 2000 w.

*30372. Tariff Changes and Customs Regulations.—Russia, France, Spain, Italy, United States, Colombia, San Domingo, Mexico, Guatemala, Peru, Uruguay, Canada, British India, Victoria, Queensland (B T J-March.) 6000 w.

*30375. Labor Bureaus.—A Conversation with the United States Commissioner of Labor. Recounted by Herbert Johnston (Ch-April.) 4200 w.

30440. The Relief Department of the Pennsylvania (R G-March 15.) 600 w.

*30445. What Is Economic Value? Arthur Kitson (A M C-April.) 2100 w.

*30452. The Cry of "Anarchist." Eugene V. Debs (A M C-April.) 1300 w.

*30453. Bimetallism vs. the Single Standard. L. Bradford Prince (A M C-April.) 4500 w

*30475. The Real "Quintessence of Socialism." W. H. Mallock (F-April.) 6500 w.

*30476. The Battle of Standards and the Fall of Prices. Edward Atkinson (F-April.) 6500 w.

*30477. Is Sound Finance Possible Under Popular Government? J. B. McMaster (F-April.) 5000 w.

*30479. Women in European Universities. Alice Zimmern (F-April.) 5500 w.

*30480. The Doom of the Small Town. Henry J. Fletcher (F-April.) 4200 w.

30509.—75 cts. The Quantity of Money and Prices, 1860-1891.—An Industrial Study. S. McLean Hardy (J P E-March.) 7000 w.

30510.—75 cts. The Relation of Sociology to Economics. Albion W. Small (J P E-March.) 5400 w.

30511.—75 cts. Public Ownership of Mineral Lands in the United States. George O. Virtue (J P E-March) 6000 w.

30512.—75 cts. Credit Instruments in Retail Trade. David Kinley (J P E-March.) 3500 w.

30513.—75 cts. Belgian Monetary Legislation. H. Parker Willis (J P E-March.) 3000 w.

†30549. A Last Tribute. Thomas B. Reed (N A R-April.) 4200 w.

†30551. The Growing Greatness of the Pacific. Lorrin A. Thurston (N A R-April.) 4800 w.

†30552. The Physician and the Social Question. Paul Gibier (N A R-April.) 3500 w.

30652. The Fall of Prices The Cause and the Cure—Need of Foreign Markets. E. Benjamin Andrews (Nat Ind Review-April.) 8500 w.

†30669. Let the People Have Relief. George W. Pepperell (A-April.) 3000 w.

†30671. The American Financial System. I. E. Dean (A-April) 5000 w.

30720. British Wheat Production Under Free Trade (S Ec-April.) 1000 w.

30721. High Wages in the United States. Emile Waxweiler (S Ec-April.) 2500 w.

30722. English Drift Toward Municipal Socialism (S Ec-April.) 3300 w.

30723. Civic Helps for Civic Life. M. M. G. Dana (S Ec-April.) 2200 w.

*30776. Wage Distribution and Average Incomes. Editorial (E-March 29) 2000 w.

*30788. Unemployment. Editorial (Eng L-March 29.) 2000 w.

†30828. The Consuls and Foreign Trade. Editorial (I R W-April 10.) 900 w.

### Serials.

28842. The Social Discontent. Henry Holt (F-Began Feb.—3 parts to date—30 cts. each).

*We supply copies of these articles. See introductory.*

# MARINE ENGINEERING

**Supersedence of Sailing Vessels.**

THE extent to which steam has superseded wind for propelling ships is conspicuously shown in the business status of the Clyde shipyards, which are feeling severely the present depression in maritime traffic. In the past, when orders for steam vessels were scanty, these yards were usually able to secure enough contracts for sailing vessels to keep them at work. But *The Engineer* (London, March 1) asserts that at present very few sailing vessels are in progress, notwithstanding the fact that such orders could be very favorably placed just now; and the vessels building have mostly been ordered by speculative men, who expect to secure future purchasers. As this condition of things is in direct contrast with previous experience, an explanation of it is offered.

"It has always been understood that in times of trade depression the sailing ship had many advantages over the steamer. If only as a cheap warehouse for the storage of goods not immediately required, she was preferred to her swifter and costlier rival, the steamer; and the preference was enhanced by the fact that she afforded abundant opportunities for speculative transactions in regard to the cargo she warehoused and carried during so many weeks at a time. Then, again, she was less expensive to build, maintain, and sail than the vessel which could be moved only by the consumption of costly fuel. But these advantages and many more appear to be now outweighed by other considerations which either did not exist or were before unknown. In the first place, continued improvements in the marine engine and in steamship design have led to greater economy in steamship working; so that the relative cheapness of carrying goods by sailing ships is not so great as it was. But, over and above this, a reason for the present falling demand for sailing ships may be found in the fact that the market is already overstocked with that commodity. So simple is their construction, and so well organized and equipped with machinery and skilled labor are our mercantile shipyards, that a sailing ship of 2000 tons register is often commenced, completed, and equipped within a space of 16 weeks. In one shipyard alone, on the Clyde, it is possible to turn out thirty such vessels in the course of a year; and probably, under pressure, even that number might be exceeded. With such facilities for supplying the demands that may arise for this description of tonnage, it is not to be wondered at that the demand is not at any time of long duration. Moreover, the trades in which sailing vessels have hitherto found their chief employment are becoming fewer in number every year."

Sailing vessels now do only those "odd jobs in the trade which it does not pay steamers to meddle with." It is asserted that large sailing ships' risks are regarded with increasing distrust by marine underwriters. "Large steel sailing vessels are more frequently lost than steamers, and their losses are very often of that mysterious and painful character described by the word *missing*. . . . They sail from a port and are never after heard of." These disasters are traced to the modern increase in the size of sailing vessels. Twenty years ago a 1000-ton sailing vessel was considered large. Now 2500-ton and 3000-ton vessels are common. Large sailing vessels are admitted to possess certain commercial advantages, but these are accompanied by preponderating disadvantages. "The four-masted monsters are not so easily handled as the vessels of moderate size, and it is to be feared that this circumstance is accountable for many losses. Then, again, as coal is a common export cargo for a sailing vessel, both from the United Kingdom and New South Wales, it cannot be doubted that so enormous a volume of that treacherous mineral as can be stowed in the undivided hold of a large sailing ship conduces to the evolution of explosive

gases, or the generation of heat during a long voyage, and this again is probably an explanation of many other large sailing-ship losses. Over and above these suggested causes is that of cargoes of grain and coal shifting in a gale by reason of absence of shifting boards, 'tween-deck feeders, and the other contrivances which experience might suggest to avoid such disasters. Taking one thing with another, large sailing ships have just now anything but a good name among merchants and underwriters; and, unless a sailing ship is large, she cannot, at present rate of freight, be worked at a profit, except for a few special trades limited to harbors with a small draft of water."

The opinion is expressed that, unless trade revives, the owners of large ships are not to be envied. The probable effect of this decadence upon the supply of able seamen is regretted. Sailing vessels have been the schools for training sailors, and the supply of officers for steamers has hitherto been from this source.

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**Proposed Lift Locks at Lockport, N. Y.**

STATE ENGINEER C. W. ADAMS has proposed, as part of the Erie canal improvements, a pair of lift locks, to be constructed under an appropriation of $100,000 asked from the New York legislature, this appropriation, according to *Seaboard* (April 3), being likely to be granted. This journal copies from the *Canal Defender* an illustrated description of the proposed locks, written by Mr. Adams. The total lift being 54½ ft., or "nearly 75 per cent. greater than the largest work of the kind ever before built," Mr. Adams says: "To construct a trough of the dimensions and capacity mentioned, balanced on a central pivot according to the European method, would require about 2.4 times as much metal as in the La Louvière lift. The weight of ram, trough, etc., exclusive of water, at the La Louvière is 492 tons. Hence, for a similar lift at Lockport, we may estimate the weight of the corresponding parts at 1181 tons, making a total weight, including water, of 2331 tons for each trough. To support this weight at the same pressure per square inch on pistons as at La Louvière (469 lbs.) would require a piston about 9 1-3 ft. in diameter. To construct such a machine would obviously be enormously expensive, even if practicable at all. Again, it will be remembered that all the canal lifts heretofore built have required from 3 to 5 years for construction. Now, making all allowances for the perfection and rapidity of modern methods of working, it may still be doubted whether it would be possible to build a structure of so much greater magnitude than any heretofore attempted in the 5 winter months which alone are available for construction work at Lockport, and during which it is absolutely necessary that it be carried to completion."

The plan presented by Mr. Adams "contemplates two steel troughs or lifting chambers, side by side. The sides of the troughs will be strongly braced, both longitudinally and transversely, to resist any deformation, either from unequal loading, from unequal adjustment of the lifting apparatus, or from the shocks of boats striking the sides. Supported by this side bracing, there will be a footway along both sides of both troughs, while a transverse footway carried by each end gate will afford means of passing from one side of the trough to the other, thus providing ready access to all parts of the trough while in motion. Underneath the troughs and spaced at intervals of 5 ft. are transverse floor-beams, which carry the troughs and their contents. To the ends of the floor-beams and outside of the troughs are fastened the chains by means of which the lifting is accomplished." Power for the entire plant will be supplied by turbines. The chains will pass over sprockets, and the weight of the troughs will be balanced by counter-weights attached to the chains. Four lines of shafting will carry the sprockets.

Omitting further details of the lifting mechanism, we will quote further only what Mr. Adams says of making the junction of the troughs with the fixed portion of the canal. This "will be made by means of a metallic wedge fitting into the space to be closed, which will also be made wedge-shaped by beveling the ends

of the troughs and of the approaches. The wedges will be fitted with rubber packing, will be moved by power, and will be so arranged as to be automatically adjustable to a varying clearance between the trough and approach. A single wedge will fit across the bottom and along the sides of the end of each trough, and will be driven home or released by a single motion." The lifts will be placed at the lower end of the present flight of locks Nos. 67 and 68. The troughs will be made to rise by deficiency of water, the counterweights then overbalancing the troughs, and lowered by surcharge, the weight of troughs and contents then overbalancing the counterweights. If a period of only 5 winter months be allowed to erect this plant and get it into good working order, all connected with the work will need to do some hustling.

### Deflections of the Magnetic Needle.

THE NAUTICAL MAGAZINE publishes a letter upon this subject by Captain J. H. Malet, which *Scientific American Supplement* reprints. The letter has principal reference to the effects of magnetic storms (often indicated by auroras) upon eccentric variations of the compass needle. After quoting Arago (1819), Dr. Robinson (1858) and Proctor (1859) to prove that "no great aurora occurs without a magnetic storm," and as magnetic storms are considered to be correlated with solar disturbances, Capt. Malet assumes apparently that, granted perturbations in the sun's photosphere of sufficient magnitude (indicated by sun spots), the magnetic storm follows, whence the aurora, which, though an effect, is itself also a cause of eccentricities of the compass needle. Whether this line of reasoning be sound or otherwise, there is little doubt of the wisdom of the advice based upon it.

"The area of a magnetic storm may be infinite, though imperceptible to the observer. When the auroral splendor is in evidence, the navigator will do well—especially when in the vicinity of land—to watch the compasses closely for any eccentric movement which they may develop, and which, undetected, might lead his ship into danger. Indeed, as many causes combine to effect these sensitive aids,—nature of cargo, heel alteration of trim, change of latitude, and proximity of land, either in following a coast line or navigating in shoal waters,—no opportunity should be neglected by night or day to determine their errors. I fear there are too many who trust their 'deviation card' on all occasions, and find, when too late, how misplaced their confidence has been. In this connection I think it would be better for all concerned if the board of trade commissioned their representatives at the annual survey to examine the sea records of the ship's compasses in lieu of the deviation card, which is often hurriedly compiled as the ship proceeds to sea after a perfunctory attempt at adjustment, often in a tideway, and which is valueless except for local application."

### Bottom Construction of Steel Vessels.

THE discrepancy between "ashore" and "afloat" strains in relation to the bottom construction of steel vessels is discussed by Joseph R. Oldman, N. A., M. E., of Cleveland, Ohio, in the *Canadian Engineer* for March. He thinks this discrepancy has been greatly misunderstood, and asserts that he has "seen ocean and lake steamers with ten or twenty consecutive floors and frames broken by light grounding, and yet the lower bottom continued keeping the ship afloat on the open sea, as if all were intact. As many are aware, when an ocean steamer constructed, say, in conformity with the 'Veritas' or 'Lloyds' Register rules is stranded under conditions which cause the bottom plating and floors to strain severely, it will usually be found that the bilge and top sides are also strained, if not fractured." It is asserted that this never occurs with lake steamers, notwithstanding their comparative lightness, one reason assigned for their exemption being that in the distribution of materials "the neutral plane is very low in the average lake steamer, as the axis is situated about two-thirds of the molded depth below the gunwale; this indicates a strong bottom and comparatively weak topsides, and the indication is cor-

rect so far as the longitudinal bending moment is concerned."

The author asks: "If a ship's bottom is proved experimentally to be amply strong for any 'afloat' stress to which it may be subject, is it necessary or advisable to increase the transverse bottom strength for the purpose of resisting rocks or uneven hard ground, which can only be resisted to a limited extent, no matter how closely the floors and frames approximate to the scantlings necessary to resist ordinary grounding strains?" The opinion is expressed that it would be better for steamers "subject to frequent groundings to leave the lower bottom about as light as it now is, but specially designed with a view to facilitate repairs, as even the lightest, well-arranged, and carefully-constructed bottoms have proved amply strong to withstand the most intense afloat stresses." But, to make surety doubly sure, he would "increase the extent, strength, efficiency, and durability of the upper bottom and bilge ceiling"; and, "as the feature desirable in bottom plating is ductility, which should not be less than 36 per cent., with a minimum tensile strength of 58,000 lbs. per sq. in.," he would "draw particular attention to these points." With reference to vessels plying in shallow waters where severe bottom damage from grounding frequently occurs, the author thinks that even "a partial remedy, or mitigation of this loss, would be of great benefit to owners of steel vessels." A 5-in. oak sheathing of steel bottoms is advocated. It is assumed that good American oak is equivalent to one-twentieth its cross-section of steel, this assumption being based on Rankine's view that oak is the equivalent of one-sixteenth its cross-section of iron. The article concludes with general remarks as to the repair of damages to ship's bottoms resulting from grounding.

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**Cleansing Ships' Bottoms by Electricity.**

IT is announced with the usual flourish of trumpets preliminary to the launching of inventions as commercial enterprises that a Kentuckian, whose name is for the present withheld, has discovered a way whereby the bottoms of sea-going vessels may be kept clean through the use of an electrical apparatus and without docking. This, if true, would be an important invention, even were the cost of the process as much as that of docking. *The Inventive Age*, which makes the announcement, says that such an invention "would be cheap at any price," but this is extravagant. The probabilities are in favor of the supposition that something of this kind will at some future time be accomplished. The industrial applications of electricity are constantly multiplying, and the announcement of almost any new use of this force now finds the public ready to receive it with credulity. It is to be hoped that the somewhat enthusiastic language of our contemporary relating to this alleged discovery or invention (for whether this yet mythical Kentuckian has discovered an invention or invented a discovery seems to us uncertain) may be fully verified by facts.

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**Whalebacks.**

DURING the 5 years in which the whaleback model of vessels has been in use, thirty-nine of these vessels have been built, and the fortieth (according to an interview with Captain McDougal, reported in West Superior, Wis., *Leader*) is now on the stocks. "'The Everett is the thirty-ninth whaleback which has been built, and the fortieth vessel is now under construction at our yards at West Superior,' said Capt. McDougall. 'We started to build the Everett when things were booming on the sound, but, as the boom petered out, we finished her up for the New York and Tampico trade. If business warrants, we will keep her on the coast, and may build more vessels. Forty vessels, including 130,000 tonnage, is a pretty good record for five years, and you can judge from that whether the boats are a success. We are in competition with no class of vessels, or with all classes, as you like. All vessels are in competition for that matter, and we are in it with the rest.'"

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**Ship-board Lodgings for Seamen.**

A LAW passed at the last session of congress has for its object to provide better lodgings for seamen than many owners

have hitherto been willing to supply. The provisions of the law, however, do not seem to afford such a marked relief from previously-existing conditions as it might have been supposed such a law would comprise. The cubic space which it demands is almost exactly what is contained in a human grave before its occupant is laid away in it,—namely, 72 cubic ft. *Scientific American* prints the text of the new law, which was approved March 2, 1895, and will take effect April 1, 1895.

"Every place appropriated to the crew of the vessel shall have a space of not less than 72 cubic ft. and 12 superficial ft., measured on the deck or floor of that place, for each seaman or apprentice lodged therein. Such place shall be securely constructed; properly lighted, drained, and ventilated; properly protected from weather and sea; and, as far as practicable, properly shut off and protected from the effluvium of cargo or bilge water; and failure to comply with this provision shall subject the owner to a penalty of $500. Every place so occupied shall be kept free from goods or stores of any kind not being the personal property of the crew in use during the voyage; and, if any such place is not so kept free, the master shall forfeit and pay to each seaman or apprentice lodged in that place the sum of 50 cents a day for each day during which any goods or stores as aforesaid are kept or stored in the place after complaint has been made to him by any two or more of the seamen so lodged. No deduction from tonnage as aforesaid shall be made, unless there is permanently cut in a beam and over the doorway of every such place the number of men it is allowed to accommodate, with these words, 'Certified to accommodate . . . seamen.'

"That the provisions of this act apply only to vessels the construction of which shall be begun after June 30, 1895."

This movement for the betterment of sailors' quarters is commendable. The law ought to have been more liberal, but it is better than nothing.

## THE TECHNICAL INDEX--1895.

*Current Leading Articles on Marine Engineering in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

*29963. The Great Steamers of Long Island Sound. Ill. William A. Fairburn (E Mag-May.) 3000 w.

*29995. Sailing Ships. Editorial (Eng L-March 1.) 1300 w.

*30000. Water Tube Boilers. Ill. W. H. Watkinson (I & I-March 1.) 4500 w.

30010. Bottom Construction of Steel Vessels and "Afloat" Stresses and "Ashore" Strains. Joseph R. Oldham (C Eng-March 1.) 3000 w.

*30020. The Screw Propeller. Ill. W. G. Winterburn (S L-March.) 4000 w.

30061. The Naphtha Launch of the Gas Engine and Power Company of New York City. Ill. (Sc A-March 16.) 1100 w.

*30192. Engineers and Ships of War. Editorial (Eng L-March 8.) 2000 w.

*30343. The Navy Estimates. Editorial (E-March 15.) 3500 w.

*30364. Speech of William Allan on the Naval Estimates (F'y-March 15.) 3800 w.

*30370. The Navigation and Industry of the Tyne. Editorial (I C T-March 15.) 900 w.

*30466. Protection to Agriculture and Shipping.—The Lubin Proposition Considered by Our Shipbuilders, with Editorial (Sea-March 28.) 1800 w.

30470. Ships of the New United States Navy. Ill. (Sc A-March 30.) 2300 w.

30533. The Screw Propeller. Ill. W. C. Winterburn (Eng-March 30.) 3000 w.

†30550. The Future of the Torpedo in War. P. H. Colomb (N A R-April.) 4500 w.

†30553. Screw Tug Steamer "Megna" for the Assam-Bengal State Railway. Ill. (I E-Feb. 23.) 1300 w.

30556. Electric Light-Ship at Sandy Hook. Ill. (E A-March 30.) 500 w.

*30621. The Navy in Parliament. Editorial (E-March 22.) 2200 w.

30692. The Deflection of the Magnetic Needle. J. H. Malet (Sc A S-April 6.) 1000 w.

30719. The Shortest Passage from China to New York. J. M. Cavarly (Sea-April 4.) 350 w.

*30826. The Economy of Sails in Steamships. Ill. C. Trolle (S L-April ) 3500 w.

Serials.

30482. Large Ships of Cellular Type. New System of Construction. Ill. William Bell (Am S-Began March 28—2 parts to date—15 cts. each).

30576. Turret Deck Cargo Steamers. S. O. Kendall (I & I-Began March 22—1 part to date—30 cts.)

*We supply copies of these articles. See introductory.*

# MECHANICAL ENGINEERING

### The Scotch Boiler.

ACCORDING to Mr. Thomas Hawley, in a lecture recently delivered at Lowell before the Wells Memorial Institute, and published in *The Safety Valve* (March 15), the type of boiler usually styled the "Scotch boiler," widely used for marine purposes, is in increasing demand for use on land. This boiler has a large bottom flue in which a grate is fitted, and which thus constitutes the furnace, and an internal back connection leading to return tubes. It is an economical steamer, but is not a cheap boiler to make. This type of boiler has the advantage that large steaming power can be put in small space. If the diameter be made large and several furnaces be used, the space occupied for a given amount of steam-generating power is perhaps smaller than that required for the same steaming capacity in any other type of stationary boiler yet produced. This is one of the chief causes of the favor for marine use with which the Scotch boiler has been so long regarded.

Many large buildings have recently been erected in American cities, particularly in New York and Philadelphia, requiring for elevators and heating a considerable amount of steam. In some cases, as in the large newspaper buildings, a considerable quantity of steam is also required for running printing machinery, and space has at the same time to be economized to the utmost. A shell of as large a diameter as the Scotch boiler admits of would not be possible in an externally-fired boiler. "The ability of a circular shell to withstand rupture varies with its diameter. One-half the pressure in the boiler is sustained by the plate upon one side, and, with a given steam pressure, the greater the diameter the larger will be the strain upon the shell; and this calls for thicker plate as the diameter increases. There is a limit to the thickness of a shell through which the intense heat from the furnace must pass, and this limit determines that externally-fired boilers must not exceed a certain diameter, and 72-in. diameter is seldom exceeded. The internally-fired boiler may have as thick an external shell as desired, and large diameters are not to be avoided, since the shell can be increased in thickness to maintain any given factor of safety. This is true also of locomotive boilers outside of the internal shells of the fire-box. Twice the heating surface can be placed in the large shell of the Scotch boiler in much smaller floor-space than in an externally-fired boiler set in brick, or in the locomotive boiler. There is this disadvantage,—that there are a number of flat surfaces in these boilers, in inaccessible places, that must be carefully braced to withstand the load that will come upon them; and American manufacturers have, as a general rule, been against using a boiler that needs an elaborate system of bracing, when a boiler equally economical can be obtained without it. Such a boiler is the common return tubular. It is a simple shell with flat heads, a large number of tubes extending through the boiler from head to head. It varies in diameter up to 72-in., and in length to 22 ft. Its circular form is nature's form for strength, and needs no bracing. The heads only need to be stayed, and that by a few braces at the upper portion of the head, since the tubes brace the lower part. In the Scotch boiler there is necessary the brace of the heads, but in addition the top and water leg at the back connection, and the stiffening of the internal shell, while the locomotive boiler needs the bracing of its crown sheet, its heads, and the water legs."

The ordinary return tubular boiler occupies large space in proportion to power generated. Mr. Hawley, while commending water-tube boilers as the safest class, and speaking highly of their economy and durability in use, corrects a prevalent notion that boilers called "sectional" are always safe by virtue of that fact alone.

He says "safety in a boiler consists in having small circular units" (of space), and also in connecting these unit spaces so "that the failure of any part of the boiler will not instantly release from pressure a large body of heated water, which by its release adds to the violence of the explosion." Some of the so called safety sectional boilers "are of large cast-iron sections, totally unbraced, and are on this account open to the objection of any flat unbraced surface; and, when any of them are connected by such a large opening between the sections that the failure of one section causes a rapid release of pressure from the other sections, this may produce a violent explosion. Cast iron is a treacherous metal to use for a boiler, but, when used, it should be carefully braced, and in a manner that will insure the braces maintaining their strength in the cooling of the casting, and so that they will not be broken by shrinking strains; and the sections of the boiler should be so placed that the steam may find prompt release, yet the connections between the sections be small enough to prevent much disturbance in the remaining sections, should one break." A subclass of water-tube boilers made of iron pipes screwed together without provision for cleaning out the pipes in case of need are condemned. The necessity for the careful and skilful setting of water-tube boilers is even more pronounced than it is with the return tubular boilers.

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**Bursting Tests of Lap-Welded Tubes.**

THE testing of both butt-welded and lap-welded pipes is a matter of common experience. In most cases the internal pressures to which pipes are subjected are so largely within that which they can withstand without bursting that the tests are instituted solely for the purpose of discovering any "pin-holes," or small leaks at the maximum pressures the pipes are intended to carry; and the test pressures are, therefore, rarely carried more than 10 or 20 lbs. above such a maximum. Occasionally, however, it has been necessary to determine the bursting pressure of pipes, in order to ascertain whether they might be applied with safety to extremely trying service. In the laying of pipe-lines for oil transportation pipes need sometimes to be subjected to the pressures of enormous heads of liquid. The specific gravity of the liquid and the head are all the data needed for computing the maximum pressure per square inch which the pipe will have to withstand; but, when this is ascertained, the question as to whether pipes of required diameter and of any particular manufacture will answer for the purpose can, in the absence of previous knowledge, be settled only by tests; and, if the pressure required approach the supposed ultimate pressure which the pipe can resist without bursting, it may be desirable to push the tests to the extent of actual rupture. The difference between the pressure at which rupture takes place and that which the pipes must successfully resist constitutes the margin in which the factor safety must be found, if, indeed, any considerable margin exists. Substantially such a case has recently occurred, and an account of it is given by M. P. S. Hildreth in *Engineering News* (March 21).

A large order for 7-in. lap-welded pipe, for use in Bolivia in a pipe-line wherein the maximum pressure was not to exceed 350 lbs. per sq. in., was divided between two well-known firms,—Morris Tasker & Company and Pancoast & Rogers. The specifications called for a test of 600 lbs. per square inch; but, in order to ascertain whether the same kind of pipe would answer for other contemplated pipe-lines in which the maximum pressure would reach 1500 lbs. per square inch, some of the pipe was tested to bursting.

"Six coupled lengths chosen at random were twice subjected to hydraulic pressure until the bursting point of a flange was reached, which occurred at 1700 and 2000 lbs. per sq. in., respectively. As in this test the longitudinal pressure was absorbed by the flange bolts only, it was decided that neither the ultimate radial strength of the pipe nor of the flanges had been reached, and therefore a new test was made under such circumstances that radial pressure only should be effective. At the second test the six lengths of pipe were

tied together from end to end by two 3 in. rods, with sleeve nuts for tightening, and the whole line securely blocked and bolted down to prevent buckling. Rupture was obtained four times. At the first trial the second pipe in the line from the pump burst 6 ft. from the middle and at a pressure of 2400 lbs., leaving a longitudinal rent 18 in. long opposite the weld. Examination showed the plate to have the same thickness of metal at this point as elsewhere, but to contain a blister about 12 in. long, which undoubtedly weakened the pipe to some extent. At the second trial a flange cracked at 800 lbs., probably because the line was not screwed up evenly. At the third trial a flange burst with violence at 2300 lbs. pressure. It was replaced by a new one. At the fourth trial a flange situated at a different joint from the last burst with a violence at a pressure of 2500 lbs., one of the fragments flying 40 ft. or more. All burst flanges in this test and previous ones were female, and broke midway between the lugs into three pieces. All fractures showed sound iron of excellent quality. The pressure was gradually applied, and the line of pipe was free from serious vibration. The gaskets used for the tests were those of guttapercha sent with the pipes, and no difficulty was found in maintaining the joints reasonably tight."

The tests were instituted and conducted by Messrs. R. W. Hildreth & Company, of New York city, who were commissioned to inspect the pipes. The weight of the pipes is stated to have been very nearly 25 lbs. per foot, and its external diameter was 7⅝ in. The thickness of the metal was therefore 5 16 in. The full description of these tests given by Mr. Hildreth is of much interest and value to mechanical engineers.

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### Rating Feed-Water Heaters.

THE question of rating feed-water heaters having been recently discussed by the American Society of Mechanical Engineers, and the necessity for adopting a uniform standard of rating having been admitted, the Feed-Water Heater Association, in a convention held January 26, adopted a set of resolutions relating to the rating and sale of these appliances. A circular containing these resolutions, accompanied by one stating the reasons for the action taken in the matter by the convention, has been promulgated. The resolutions to which the several members of the association have subscribed, and which they have pledged themselves to carry out both in letter and spirit, are as follows:

"That we believe that the only proper rating for feed-water heaters is based upon the square feet of heating surface contained in the heater. For the purpose of giving practical shape to this belief, we do further resolve:

"That we hereby agree that we will, in each and every case in which we are called upon to make prices upon heaters, state the exact number of square feet of surface which we are offering. To give further effect to this action, we resolve:

"That we will, in each and every case, state without reservation, both in our printed catalogues and in our specifications, the diameter of the tubes, the number of lineal feet thereof, and the total square feet of heating surface in each heater offered."

A further resolution authorizes the secretary to invite all closed-heater manufacturers to join the association and coöperate with it in adopting the system of rating named in the resolutions. In the secretary's letter the absurdity and inconvenience of a horse-power rating is set forth. "The work which a feed-water heater has to do depends upon the number of pounds of water in the shape of steam that an engine requires per hour. A single engine, of the cheapest grade, may use, say, 50 lbs. of water per horse-power per hour; an average engine will use perhaps 30 lbs. of water; while a high-grade engine will cut the consumption of water down to something like 15 lbs. per horse-power, per hour. Again, the steam which is used to heat this water will, in the case of a simple engine, have a temperature of 212°, while, in the engines of high-grade, it may have to do its work with a temperature of less than 150°."

The resolutions are signed by the follow-

ing well-known feed-water heater manufacturers: The Taunton Locomotive Mfg. Co., makers of the Wainwright feed-water heater; Benj. F. Kelly & Son, makers of the Berryman feed-water heaters; Wm. Baragwanath & Son, makers of the Wm. Baragwanath feed-water heater; the Goubert Mfg. Co., makers of the Goubert feed-water heater; The National Pipe Bending Co., makers of the National feed-water heater; Robt. Wetherill & Co., makers of the Wetherill feed-water heater; and the Keystone Engine and Machine Works, makers of the Keystone feed-water heater.

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**Brass and Bronze in Cincinnati.**

WE are in receipt of the first number of a new industrial monthly, published at Cincinnati, under the title, *Ohio Valley Industrial Review*. The pages of this monthly are 9 in. by 12 in., each containing three columns of printed matter. As indicated by the name adopted, this newcomer is devoted to the industrial interests of the Ohio valley, of which it justly regards Cincinnati as the center. We are informed by a letter from the publishers that it is their intention to revise "the best trade papers in each line, after the manner of *The Review of Reviews*." This feature is not, however, embodied in this number. The publication is well edited, and contains a goodly number of signed articles, some of which are illustrated. We are pleased to extend a welcome to our new contemporary.

In an article entitled "Manufacture of Brass and Bronze Goods," written by Mr. Jamis Powell, the importance of Cincinnati as a manufacturing center in this line is indicated.

"The casting and founding of bells in this city constitutes the specialty of one of the most extensive establishments of this class in the country, embracing the production of all kinds, from the smallest plantation bell that invites the dusky laborer to his noon-day meal to the huge tower bell that sounds the note of alarm and arouses the 'fire laddies' to do valiant battle with the Fire Fiend; and many are they who in town, city, and country are invited to the house of worship by the chiming peals of Cincinnati bells from turret and spire.

"Cincinnati has become the noted center and source of supply to a constantly increasing and widening circle of consumers of the various articles in brass and bronze. Besides the numerous establishments of lesser degree devoted to this branch of industry, the 'Queen City' can boast of two of the very largest establishments specially engaged in this branch of business that can be found in the United States. The reputation of these establishments for excellence in the line of their manufacture is not surpassed, if equalled, anywhere; their goods are distributed throughout the length and breadth of the land, and both establishments are well represented by foreign agents, who find a ready and growing demand for their products; and it may be confidently claimed that the brass manufactures of the Queen City of the West will continue to augment and maintain a dominant factor in her industrial prosperity."

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**Steam Freighting with Traction Engines.**

IN California not only is steam freighting with traction engines largely practised, but its use, according to the *Mining and Scientific Press*, is decidedly increasing. That paper (March 9) prefaces an illustrated description of a wagon train drawn by a traction engine with a load of 40 tons and capable of ascending a grade of 500 ft. to the mile with the remark that high-power traction engines are not only extensively, but also profitably, employed in California in this traffic. The train described "is now in use in hauling salt a distance of 30 miles over the desert in San Bernardino county in this State, from the mines of the Crystal Salt Co." to Danby, a point on the Atlantic and Pacific railroad, to be shipped to different points. This route is somewhat sandy; the train, however, makes the round trip (60 miles) in one day and a half, including loading and unloading. The cargo averages about 40 tons at each load. That is a very trying place to operate a train, owing to the loose sand to be contended with and the scarcity of water for the engine, the

water being hauled in sufficient quantity from one end of the road by the engine to supply it for the round trip. However, the train is a success there, and makes it possible to market one of the great resources of this State that otherwise would lie dormant for want of a way of getting it to a shipping-point on the railroad."

"These engines are also extensively used in California for hauling logs to the mills, and lumber to the market,—some large firms owning as many as three and four each,—and at a profit considerably over that of employing animals, which were formerly used by them, the engines doing the work much more satisfactorily." A firm in Mendocino is cited as now using only two horses, whereas two years ago one hundred and fifty were used, traction engines having now supplanted animal power. It is also asserted that lumber men run their engines up grades of 800 ft. per mile in going after logs.

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### Who Invented the Trip Cut-Off?

FREDERICK E. SICKELS, or George Corliss,—to which should be awarded the honor of inventing the trip cut-off? This, like many other questions of prior invention, is likely to give rise to an active, if not a rancorous, controversy. The recent announcement of the demise of Mr. Sickels seems to have suggested the present as a fitting occasion for the revival of this question by an anonymous writer in *American Machinist*. This writer has gone over the whole life of Mr. Sickels, evidently with the impression that Corliss, by his superior address, won wealth and fame that should have descended upon Mr. Sickels. An editorial on the subject appears in the same paper, and also a letter from Mr. Charles T. Porter, who in steam-engineering circles is scarcely less famous than Sickels and Corliss. Both of the latter have now left the scene of controversy, and we hope the discussion thus opened will not result in dishonor to either. The editor of *American Machinist* says: "As to the strife which arose between Sickels and Corliss, we give simply the facts as we have found them. As is well-known, we have never been at all backward in according due honor to George H. Corliss either during his life-time or since its close. He was without a doubt one of the world's great engineers, and did much to advance steam-engineering practice. Wherein the account published in this issue seems to detract from his fame, all we can say is that we cannot help it. The facts are given as we have found them, and our sense of justice compels us either to publish them as found or say nothing on the subject, and we have chosen the former alternative. Men familiar with the case declare that the decision of the court in favor of Corliss hinged mainly, if not entirely, upon the assumption (supported by the testimony of experts) that the *spindle* of a cylindrical oscillating valve differed so much from the *stem* of a puppet valve that a drop cut-off arrangement applied to the former was not mechanically equivalent to such an arrangement applied to the latter form of valve. Everybody knows that this is exceedingly fine hair-splitting, and it is evident that, if the decision was founded upon this assumption only, then the board of judges on steam machinery at the Centennial was justified in awarding to Sickels the credit of the invention of the drop cut-off, which Mr. Chas. T. Porter, in his exceedingly interesting letter, says they did do. We have spared neither pains nor expense to obtain and publish either a facsimile of this original award or a copy of it, believing there are many who, like Mr. Porter, would wish to see it made public; and Mr. Porter's letter is an ample comment upon the circumstances connected with the award. We hope yet to be able to publish the award."

The article which called out this editorial expression gives an interesting biographical sketch of Mr. Sickels, tracing his boyhood till it took him into the once famous Allaire Works in New York city. Here, as an apprentice boy, he conceived and wrought out the invention with which his name will ever be associated.

"At the age of 19 or 20 years, he devised his brilliantly simple method of obtaining the quickest closing valve possible,—an invention worthy to rank with James Watt's simple ideas of separating

the condenser from the cylinder and using steam on both sides of the piston, which were the foundation, and, except details, the sum of his invention.

"With the heavy parts of such engines as Sickels, the Allaire apprentice, was familiar with in his daily life in the Allaire shops, no rapid action was possible; therefore, with that simple directness which marks inventive effort of the highest order, with that boldness and certainty of the correctness of his convictions which leads genius to its successes and the religious zealot to the stake, Sickels cut the steam admission valve away from all its massive actuating parts, so that he could have a small light piece only to move. No bolder thought in steam engineering exists than this conception of the apprentice boy of the Allaire Works. Of all the parts of the steam engine the steam admission valve must be most surely placed and handled; its time of movement must be precisely fixed with relation to piston position. To let go of this valve at one point so that the valve might be as light and hence as quickly moved as possible, and to pick it up again so as to move it with absolute certainty as to time and space, and to do this new thing with noiseless and durable mechanical elements, was the formidable task to which the boy Sickels betook himself. He succeeded amid the sneers and jeers of the recognized masters of his craft, and he reached his reward,—a life of unremitting toil, unending disappointments, poverty, actual want, the receiving of charity, and a recognition at last as one of those whose names are to live after death. It is true that Sickels saw the whole steam-using world adopt his invention of the trip "cut-off valve, the detached rapidly-closing steam admission valve, but it was as the "Corliss," not as the "Sickels," engine.

The article presents a statement that George H. Corliss was contemporaneously an apprentice with Sickels in the Allaire Works. This allegation is made on the authority of a sister of Mr. Sickels, who also says that the latter showed, explained, and talked over his invention with Corliss. The statement that Corliss and Sickels were apprentices in the works at the same time is also alleged to be corroborated by the testimony of one Richard Ryan, who was at the Allaire Works in 1844.

"Certain it is that Corliss, almost contemporaneously with Sickels, began his life-work on detaching valve-gear; certain it is, also, that, although Sickels gained some barren victories over Corliss in the courts, which were unsupported by such subsequent proceedings as might have made Sickels rich and famous, Corliss retained to the last the credit of the invention of the cut-off, millions of money."

Mr. Porter, who was one of the judges at the Centennial Exhibition who made the award to Mr. Sickels, above spoken of, says in his letter that the award "was signed by every member of the board," including Horatio Allen (another honored name in the history of steam engineering), who had formerly not been on good terms with Mr. Sickels, but who remarked concerning the award that "it was fully deserved, and that he should sign it with pleasure." Mr. Porter adds: "This award never saw the light. It was thrown out by the committee of revision, of which George H. Corliss was chairman." *American Machinist* promises in an early issue a review of the famous legal contest between Corliss and Sickels, from the pen of Mr. W. F. Durfee.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Mechanical Engineering in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

### The Machine Shop.

30281. Heel Core Prints and Their Core Boxes. Ill. John M. Richardson (A M-March 21.) 1200 w.

30284. Cutting Square Thread Screws. Ill. A Mechanic (A M-March 21.) 3000 w.

*30624. An Experimental Theory Concerning the Shearing and Punching of Metals. M. C. Fremont (C G-March 22.) 700 w.

30683. Casting a Gun by the Rodman Process. Ill. G. A. Webster (A M-April 4.) 1300 w.

*We supply copies of these articles. See introductory.*

### Steam Engineering.

30095. Traction Engine and Train for Steam Freighting. Ill. (M S P-March 9.) 800 w.

30114. The Dryness of Steam. W. H. Booth (A M-March 14.) 1600 w.

30116. A Diagram of a Corliss Valve Motion. Ill. Sterling H. Bunnell (A M-March 14.) 1600 w.

30119. Boiler Heating Surface. Conrad Skarstedt (A M-March 14.) 1000 w.

30143. Boiler. A Note on Evaporative Tests. John C. McMynn (E E-March.) 700 w.

30144. Covering for Steam Pipes and Boilers. James Collopy (E E-March.) 500 w.

*30169. Smoke Prevention Appliances. Editorial (P Eng-March 8.) 1200 w.

*30228. Calorific Values of Different Fuels. R. C. Carpenter (S J E-March.) 3500 w.

*30229. A Graphical Method for Correcting Calorimetric Determinations. C. H. Bierbaum (S J E-March.) 1100 w.

*30233. Steam Engine Economy. Ill. T. W. Graham (Mill-Feb.) 1500 w.

30283. Notes on Piping.—Faulty Fittings. Ill. (A M-March 21.) 1300 w.

30330. Combustion of Fuel, Evaporation, Strains, Injectors, Firing. Properties of Steam. —A Short Lecture on Boilers Addressed to Practical Men (S V-March 15.) 3500 w.

30331. Tesla's Steam Engine (S V-March 15.) 1000 w.

30355. Boiler Piping.—How Done in Some Large High Pressure Plants. Ill. Discussion Before the A. S. M. E. (B J C-March 23.) 1800 w.

30356. A Violent Boiler Explosion.—A Webster Woolen Mill Wrecked (B J C-March 23.) 1000 w.

30505. The Efficiency and Capacity of Steam Fire Engines, with Editorial (E N-March 28.) 2800 w.

30571. A Comparison of Boilers. Thomas Hawley (S V-March 15.) 2700 w.

*30595. The Making of Steam. Editorial (Eng L-March 22.) 2000 w.

*30643. Steam Engine Economy. Condensing Engines. Henry Davey (I C T-March 22.) 1300 w.

*30666. The Howden System of Forced Combustion for Steam Boilers. Ill. G. W. Dickie (I S F-April.) 2500 w.

*30695. Hard Firing. Anon. (M W-March 29.) 900 w.

30740. The Rice and Sargent Engine. Ill. (E R-April 6.) 1700 w.

*30746. Steam Boilers, C. R. Tompkins (Am M-April.) 1200 w.

30799. The Future of the Steam Engine. Foree Bain (E I-April.) 1200 w.

### Miscellany.

*29958. The Educational Influence of Machinery. A. E. Outerbridge, Jr. (E Mag.-May.) 3000 w.

*29962. A Marvel of Mechanical Achievement—Origin, Evolution and Perfection of the Bicycle. Ill. Robert Perkins (E Mag-May.) 3000 w.

30028. Planing Mill Practice. C. R. Tompkins (A S-March 9.) 1200 w.

30099. Do Patent Laws Retard Progress. Eugene L. Arnott (I Age-March.) 1500 w.

30118. Force, Energy and Power. P. Lobben (A M-March 14.) 2000 w.

30124. The Purchase of a Pump. Anon. (P A-March 15.) 3000 w.

*30200. Apprenticeship. S. E. Dibble (D E-March.) 1200 w.

30215. A New Definition of Energy—Using and Wasting of Coal. Anon. (T-March 15.) 800 w.

*30219. Remarks on Winding Engines. (Abstract.) A. M. Grant (I C T-March 8.) 2000 w.

*30231. The Manufacture of Saws. Henry H. Ritter (S J E-March.) 1600 w.

*30234. Diamond-Set Stone Saws. Anon. (S-March.) 2000 w.

30266. That Obnoxious Patent Statute—Observations on Professor Elihu Thomson's Letter. George C. Maynard (E R N Y-March 20.) 600 w.

30276. Revelations in the Combustion of Oil. Gas, and Gasoline. Ill. C. H. Land (H & V-March 15.) 1000 w.

30279. A Motor Operated by the Expansion and Contraction of Metal. Ill. (Sc A-March 23.) 350 w.

†30300. Mechanical Integrators. Ill. J. Burkitt Webb (S In-Jan.) 8500 w.

†30301. Tests of Automatic Sprinkler Heads. D. S. Jacobus (S In-Jan.) 1500 w.

30315. Tests of Lap-Welded Iron Pipe. P. S. Hildreth (E N-March 21.) 2000 w.

†30323. Garnet as an Abrasive Material. Ill. F. C. Hooper (S M Q-Jan.) 1100 w.

30333. Economy in Air Compression. Frank Richards (E M J-March 23.) 1900 w.

*30351. Overhanging Beam Pumping Engine and Crown-Valve Exhaust Gear. Ill. John G. Barclay (C G-March 15.) 500 w.

*30381. Centrifugal Fans. James Dunlop (P Eng-March 15.) 900 w.

*30397. How Shall Machinery Be Rated? The Pros and Cons Discussed in the House of Commons (M-March 15.) 3300 w.

*30398. Machinery in South Africa—Power and Plant for the Goldfields at Work and on Order (M-March 15.) 2000 w.

30434. A Handy Cable Testing Arrangement. Ill. H. Loewenherz (E E N Y-March 27.) 700 w.

30438. The Lombard Water-Wheel Governor. Ill. (E R N Y-March 27.) 1800 w.

30441. Making Tight Joints with Locknuts and Long Threads. Otto Luhr (S E-March.) 700 w.

30443. Ammonia Condensers. Otto Luhr. From Ice and Refrigeration (S E-March.) 700 w.

30456. The Proposed New Standard Screw

Thread.—Skill Required in Machine Shops. Ill. John A. McGregor (A M–March 28.) 1500 w.

30457. "Acme Standard" Screw Thread. Table Arranged by W. S. Dix (A M–March 28.) 250 w.

30458. Small Gas Engines—Firing Bituminous Coal. W. H. Booth (A M–March 28.) 2300 w.

30485. Labor as a Factor in Manufacturing. James Spiers (M S P–March 23.) 1500 w.

*30493. Danger Signals. Robert W. Lyle (B B–March.) 3600 w.

30508. Rail-Loading Machine; Lackawanna Iron and Steel Company. Invention of John A. F. Svenson (E N–March 28.) 900 w.

†30531. Saving Power. R. J. Abernathey (I Eng–Feb. 23.) 1100 w.

30538. Machine-Tool Nomenclature. Oberlin Smith (M A–April.) 1400 w.

30540. Gas Engines vs. Steam Engines. A. Bollinckx (M A–April.) 600 w.

30541. Cone Pulleys and Belts. W. L. Cheney (M A–April.) 2700 w.

30557. Changes in the Fire Brick Industry. Ill. C. F. S. (I T R–March 28.) 1500 w.

*30584. Hand and Rede-Craft. Daniel C. Gilman (I C B–March 22.) 1800 w.

30660. Traveler Employed on the Park Avenue Improvement. Ill. (Ir Age–April 4.) 1000 w.

30663. H. S. Maxim on English Labor. From the N. Y. Sun (Ir Age–April 4.) 4000 w.

*30665. Early History of Wood-Working Machines. John Richards (I S F–April.) 7000 w.

30680. Riveted Joints. O. P. St. John (Pr–April.) 900 w.

30682. Frederick E. Sickels, Inventor. Ill. (A M–April 4.) 7000 w.

30686. Manufacture of Lead Pipe. Ill. (Sc A–April 6.) 600 w.

30739. Improvements in the Lonsdale Company's Power Plant. Ill. (E R–April 6.) 2400 w.

*30745. Development of Gas Engines. Charles Quast (Am M–April.) 1500 w.

*30775. The Power Absorbed by Rope and Belt Transmission. Editorial (E–March 29.) 1800 w.

*30795. Fire Extinguishing Extraordinary. —The Grinnell Sprinkler (Tr–March 29.) 2800 w.

Serials.

18044. Motive Power and Gearing. Ill. E. Tremlett Carter (El–Began Dec. 1, 1893—32 parts to date—30 cts. each).

19638. Blowing Engines and Machinery. Ill. Albrecht von Ihering (E M–Began Feb., 1894—12 parts to date—30 cts. each).

20182. The Elements of Boiler-Making. Ill. C. E. Fourness (L E–Began March, 1894—13 parts to date—30 cts. each).

21141. High Speed Steam Engines. Ill. John Radinger (E M–Began April, 1894—13 parts to date—30 cts. each).

24338. The Gas Engine. Ill. Anon. (P A–Began Aug. 15, 1894—11 parts to date—15 cts. each).

24930. Some Notes for Enginemen and Firemen. W. H. Booth (E L–Began Aug. 31—16 parts to date—30 cts. each).

25528. The Designing and Construction of Modern Steam Engines. Ill. Theodore F. Scheffler, Jr. (M A–Began Oct. 1894—7 parts to date—15 cts. each).

27633. Engine Governors and Governing Mechanisms. Ill. R. Gordon Blaine (M W–Began Dec. 7, 1894—6 parts to date—30 cts. each).

28021. Attachments and Conveniences for Universal Milling Machines. Ill. Warren E. Willis (A M–Began Dec. 27, 1894—4 parts to date—15 cts. each).

28400. The Building of a Locomotive Boiler. W. D. Wansbrough (M W–Began Jan. 4—Ended March 15—6 parts—30 cts. each).

28745. The Trials of Oil Engines at Cambridge (P Eng–Began Jan. 18—Ended March 8—7 parts—30 cts. each).

29630. The New Nordenfelt Guns. Ill. (E–Began Feb. 15—7 parts to date—30 cts. each).

29777. The Deterioration of Locomotive and Marine Boilers Due to Expansion, and the Means of Lessening the Same. Ill. Herr Lentz (A E R J–Began March—2 parts to date—30 cts. each).

29886. Defects in Steam Boilers. Ill. From Report by the Austrian Association of Engineers and Architects (Ir Age–Began March 7—2 parts to date—15 cts. each).

30098. Inventions in the Wool Manufacture. S. N. D. North (I Age–Began March—1 part to date—15 cts).

30216. Care and Maintenance of Machinery. "Quirk" (T–Began March 15—1 part to date—15 cts).

30285. Engine Cylinders and Bed Finishing—Methods and Tools. Ill. Herman Landro (A M–Began March 21—1 part to date—15 cts).

30456. The Cornell Dividing Engine. Ill. George F. Ballou (A M–Began March 28—1 part to date—15 cts).

30555. The Proportions and Movement of Slide Valves. W. D. Wansbrough (M W–Began March 22—1 part to date—30 cts).

30617. The Making of a Bicycle. Ill. Anon. (E–Began March 22—1 part to date—30 cts).

30751. Forced Draft, and Atmospheric Condensing, for Steam Power Plants. Ill. Robert D. Kinney (E M–Began April—1 part to date—30 cts).

30810. Blast Pipes and Serve Tubes in Locomotives. Ill. (P Eng–Began March 29—1 part to date—30 cts).

30811. Experimental Theory of the Punching and Shearing of Metals. Ill. C. Fremont (P Eng–Began March 29—1 part to date—30 cts).

# MINING & METALLURGY

### A Triumph of Engineering Skill.

THE hard-coal Jeddo basin is about 40 miles from Wilkesbarre, and near to the highest point in Pennsylvania. The coal of this field, discovered some 10 years ago, is exceptionally good, and has commanded the highest prices. Three shafts were sunk, and prosperous villages grew up around them; the operators were making large profits, and everything was most promising. But in the spring of 1887 headings driven too near the surface caved in, and the waters of the creek suddenly flooded the workings, hundreds of the miners barely escaping with their lives. For over 2 years the district was practically deserted, hoisting-engines rusting and the great breakers falling to pieces. But the large reserves of coal were too valuable to be abandoned without an effort. Pumping out the 500,000,000 gallons of water and the steady inflow seemed impracticable. So in 1890 the operators agreed upon a plan for draining the mines by means of a 5-mile tunnel, an enterprise which was regarded by some as a probable loss of $1,500,000, in view of uncertainty as to the ground to be penetrated, there being some chance of encountering quicksand.

The *Bulletin of the American Iron and Steel Association* quotes from an exchange the details of this great work. The length of the tunnel is about 5⅛ miles, passing under two mountains and under the lowest workings (450 ft. deep) of the mines, and discharging into Butler creek. Two shafts were sunk to the tunnel-level, and progress was thus made in five headings, —two each way from each shaft and one from the tunnel mouth. Five gangs of men, fifty in each, were employed. Progress was slow, owing to hardness of the rock, necessitating constant blasting. Power-drills operated by compressed air were employed, and altogether 350,000 lbs. of forcite were used in blasting. The dimensions of the tunnel as originally planned were 8 by 8 ft., but the contractors, finding this an inconvenient cross-section, changed to 7 by 9 ft. and made faster headway. Water was encountered in quantity, and seven pumps were kept busy clearing the unconnected drifts. The surveys appear to have been very accurate. The first connection, between headings Nos. 3 and 4, was made in September, 1894, and the alignment found to be perfect, there being not more than an inch difference in the floors of the two sections. Soon afterward the connection between Nos. 1 and 2 and the outlet was made. Meanwhile, as the tunnel was nearing completion, a bore hole was put down from the surface, passing through one of the flooded gangways, and piercing the center of the roof of the drainage tunnel. This bore was so accurate that it came out within a 6-in. circle marked in the tunnel roof. It was so well cased that only "about a gallon a day" leaked into the tunnel. To withdraw the 6" × 4" hickory plug and the casing was the work of but half an hour, and the mines were successfully tapped. Some delay was caused by an injunction granted to a farmer in Butler Valley, who feared damage to his land by flooding; but this was adjusted, it being shown that the water would pass out at a rate of only about 8000 gallons per minute. The right of way past other lands had previously been secured by the operators. A gratifying feature of this great undertaking is that not a man was killed, despite the amount of blasting done, and only four men injured in any way. The tunnel is expected to bring prosperity back to a long desolate region.

### The Genesis of Ore Deposits.

ONE of the most notable recent contributions to the science of economic geology, viewed from the theoretical standpoint, is the criticism by Prof. Joseph Le Conte (offered at the Bridgeport meeting of the American Institute of Min-

ing Engineers) on Bergrath F. Posepny's great essay on the genesis of ore deposits. This latter has elicited much interesting and some useful discussion. After doing jnstice to the high merits of Posepny's treatise, Prof. Le Conte "cannot but think that he [Posepny] carries his ascension views much too far; that, in his zeal against the extreme lateral-secretion views of Sandberger, he has gone to the other extreme of ascensionism; and that a truer view than either may be found in one that shall combine and reconcile these two extremes." It will be remembered that Posepny draws a sharp distinction between the superficial and the deep circulation of underground waters: the water in the former case containing air, and therefore oxidizing; the water in the other case being destitute of air, and therefore non-oxidizing; the one circulation being driven by gravity alone, the direction of current being determined by the plane of outflow; the other being driven largely by heat received in the lower parts of its circuit, and the direction of its current being mainly upward,—from which view it follows that metallic sulphids are not deposited from the waters of the "vadose" (superficial) circulation, unless under the exceptional conditions of the presence of excess of organic matter; and therefore that the presence of metals in the form of sulphids is usually a sign of deposit from ascending waters of the deeper non-oxidizing circulation. Posepny has also introduced, as a substitute for the indefinite "unknown depths" of other geologists, the term "barysphere" to define a region in the interior of the earth, the materials of which are heavier, because more metalliferous, than the superficial "lithosphere" visible to us. This "barysphere" would therefore be the source of ore deposits, and not the higher rocks; but Sandberger and his followers have demonstrated by refined analyses that these upper rocks, especially in their heavier basic mineral constituents, contain the metals in sufficient quantity to form ore deposits by leaching, concentration, and precipitation.

Prof. Le Conte, inquiring whether there is a "barysphere" within reach of circulating water, admits (as all do) that there must be such a region somewhere, but doubts whether it is near enough to the surface. The mean density of the earth as a whole being about 5.5, while that of the surface rocks is about 2.5, he argues that, assuming the simplest rate of increase,—a uniform one,—the central density would be 14.5, and an actual density equal to the mean density would be found at a depth of 1000 miles. At a depth of 100 miles, therefore, the increase would be 0.3 and the density only 2.8; but that is only about the density of the more basic eruptives. But Prof. Le Conte does not believe it probable that circulating water ever comes up from any such depth. It may come, he thinks, from as deep as ten miles, where the increase over the superficial density would be wholly inappreciable. If the rate of increase is not uniform, on either explanation of the high mean density of the earth, whether (1) by condensation by increasing pressure or (2) arrangement of materials of a primal fused earth according to their relative specific gravities,—the probability being in favor of both causes,—at all events the increase must be progressive toward the center, and he thinks it hard to conceive the conditions under which a dense metalliferous shell a little way beneath the surface could be formed. From a chain of reasoning which cannot be followed here he concludes that below a certain moderate depth—say 8 or 10 miles—there is no true circulation. Below this the compactness of the rocks from increasing pressure would inhibit further penetration; while capillarity, which strongly impels movement in dry porous materials, also acts as strongly to retard it, once the rocks become saturated.

Prof. Le Conte believes that a more comprehensive theory than the ascension or the lateral-secretion theories is needed, and that, in the uncolored light of a broader view, many of the difficulties and obscurities of the subject disappear. His general conclusions are:

"1. Ore deposits, using the term in its widest sense, may take place from many kinds of waters, but especially from alkaline solutions; for these are the natural

solvents of metallic sulphids, and metallic sulphids are usually the original form of such deposits.

"2. They may take place from waters at any temperature and pressure, but mainly from those at high temperature and under heavy pressure, because, on account of their great solvent power, such waters are heavily freighted with metals.

"3. The depositing waters may be moving in any direction,—up-coming, horizontally moving, or even sometimes downgoing, but mainly up-coming, because by losing heat and pressure at every step such waters are sure to deposit abundantly." [This has been used by some as an argument that mines, as a general rule, increase in richness with depth,—a state of things not substantiated by experience.]

"4. Deposits may take place in any kind of waterways—in open fissures, in incipient fissures, joints, cracks, and even in porous sandstone, but especially in great open fissures, because these are the main highways of ascending waters from the greatest depths.

"5. Deposits may be found in many regions and in many kinds of rocks, but mainly in mountain regions and in metamorphic and igneous rocks, because the thermosphere is nearer the surface, and ready access thereto through great fissures is found mostly in these regions and in these rocks."

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### North Carolina Monazite.

INQUIRIES having been made of this department as to the character and uses of this peculiar mineral, monazite, the following facts, taken from a paper read by Mr. H. B. C. Nitze before the American Institute of Mining Engineers, will be of interest as giving information additional to what has already been published. Monazite is a phosphate of the rare earths,—cerium, lanthanium, and didymium. It also contains thoria and silica in varying percentages, probably as impurities. Its economic value lies principally in the thoria which it contains; this is used as one of the constituents of the mantles for the Welsbach and other incandescent gaslights. Although somewhat widely distributed, monazite, until now, has been found in commercial quantities only in Brazil, Siberia, Norway, and North and South Carolina. The whole North Carolina area contains between 1600 and 2000 square miles, but the mineral is only found in scattered localities along creeks, mainly in four counties, with some less important outlying occurrences. It occurs in the sands and gravels of the stream beds, associated with other minerals, such as quartz, feldspar, hornblende, epidote, magnetite, etc., and is separated from most of these, owing to its superior specific gravity (4.9 to 5.3), by washing in sluice boxes in much the same way as placer gold is won, the heavy magnetite, however, being removed by treating the dry sand, after washing, with a magnet.

The primary sources of monazite are the crystalline gneisses and schists, of which it is an accessory constituent. By the decomposition and disintegration of these rocks and a natural process of partial sorting and concentration the stream deposits are formed. The percentage of thoria is variable, and the value of the mineral consequently varies accordingly, and must be determined by analysis. It is stated that the transparent greenish and yellowish-brown varieties are usually the richest. Some high-grade specimens have from 4 to 6.60 per cent. of thoria; other good samples run from 2.76 to 3.30 per cent.; but the fluctuations are considerable, even in the same locality. The commercially-prepared mineral, after being washed over several times and treated with a magnet, is not pure monazite, as the concentrate may contain several of the other heavier non-magnetic minerals. A cleaned sand containing 60 per cent. of monazite is considered good.

The stream deposits are from 1 to 2 ft. thick, the width seldom being over 12 ft. The sluice boxes are about 8′ × 20″ × 20″. Two men work at a box, one digging the gravel and shoveling it into the box, the other working it up and down with a gravel fork or perforated shovel. The boxes are cleaned up after the day's work. From 30 to 35 lbs. of cleaned monazite sand per hand is a good average. The value of

the best grades is 6 to 7 cents per pound at the diggings. In the last 2 years the North Carolina shipments were reported as 546,855 pounds, worth $36,192. This is considerably less than some of the highly-colored accounts would indicate.

### A Great Copper Mine.

TAMARACK mine, Keweenaw peninsula, Lake Superior, Michigan, is described by Mr. Charles S. Herzig in the *Colliery Engineer* for March. The district is the second largest copper producer in the world, Montana now leading, and in it the Tamarack is second in importance only to the famous Calumet & Hecla, which has paid $41,000,000 in dividends. The bed the Tamarack is working on is known as the Calumet & Hecla conglomerate, and outcrops for 4200 ft. in the property of the mine from which it was named. The latter mine had followed it down by a series of inclines about 600 ft. apart, the bed dipping toward the Tamarack ground on the west, at an angle of 38°. Under the advice and management of Capt. Daniell, of the Tamarack company, a full-sized vertical shaft, 8 by 20 ft., was sunk to tap the bed at a depth of over 2000 ft. After an outlay of $700,000 and at the end of 2 years, this very plucky enterprise, as Mr. Herzig well terms it, was rewarded by a striking of the lode at 2200 ft., and within a very few feet of the calculated distance. This was in 1882. Later shaft No. 2 was started, and it struck the lode at 2000 ft. in 1884.

The deposit is a peculiar one, its regularity never having been equalled in any other metal mine. As far as explored, the dip is almost uniform—38°. Its thickness is from 8 to 21 ft., averaging about 12 ft. Copper is disseminated through it in metallic particles, from microscopic size up to large masses. The conglomerate is very coarse, containing large pebbles cemented together by silicious matter and frequently by the copper itself. In opposition to the general rule, the deposit has held out in depth without change,—not with the usual alteration products of oxidation at the surface running into sulphids in depth, but containing native copper at all depths.

The new shafts, Nos. 3 and 4, are the two deepest shafts in the world. No. 3 struck the lode in August, 1894, at a depth of 4185 ft. vertical, and No. 4 will have reached it at about 225 ft. deeper before this notice is printed. These shafts were sunk at the rate of about 80 ft. per month, No. 4 having been sunk 977 ft. last year.

The surface plant is extensive, there being two hoisting engines for each shaft. No. 2 shaft, described by Mr. Herzig as typical, has three compartments, two for the main cages and one for the tool cage. Surface water is taken care of by small pumps. No heavy pumping engines are needed, the mine being so dry that a tank-car making ten or twelve trips daily easily handles the water.

From each shaft a series of cross cuts, 60 and 80 ft. apart vertically, are run to the lode, and levels opened each way along it. All the material, from wall to wall, is stoped out, and very heavy timbering is required, there being very little waste for filling. The percentage of copper in the conglomerate varies between 1 and 3½ per cent. of all the rock mined. The ore is crushed by drop hammers, screened over grizzlies, and crushed again by five large Blake crushers to about the size of a fist; the masses of pure copper and the rich *epidote* boulders are picked out by rough hand-sorting as a special grade; and the rest is sent to the mills, where it is further reduced by steam stamps, and concentrated. The concentrates are then smelted into ingot copper.

### Recent Development of the Coke Industry.

A VERY concise review of the world's coke industry—a great one in all iron-making countries except, perhaps, Sweden—is given in the *Colliery Guardian*. Remarkable progress has been made within recent years in two directions: first, in the increase in the number of coke-making plants; and, second, in the transition (on the continent of Europe at least) from the old-fashioned forms, and especially the beehive, to the newer types, originated and adopted chiefly in German and Belgium, which enable the tar and ammonia by-products to be saved.

In the United States, in the 14 years beginning with 1880, the Connellsville region (Pennsylvania) has doubled the quantity of the yearly coke output, or 5,454,000 tons in 1894 against 2,206,000 tons in 1880, the number of ovens increasing from 7,211 to 17,834 in the same period. As the development of this region has been comparatively recent and so rapid, it would be reasonable, remarks the *Colliery Guardian*, to look for a general adoption there of the newest types of oven and the most advanced modes of manufacture. Such, however, has not been the case. The coke industry of the United States has followed the practice of Great Britain in adhering to the beehive system, in which no attempt is made to recover the by-products, and where an enormous waste of valuable residue is allowed to go on. Our contemporary suggests that this may be mainly due to the fact that coke can be manufactured in the Connellsville and other leading districts so cheaply that there has hitherto been little inducement to make it any cheaper. In the last two years the Connellsville price has touched 90 cents a ton, the average for 1894 being about $1.04. This cheapness of coke has greatly lowered the cost of making pig iron, but there can be little margin for profit to the coke manufacturers. Experiments made in Germany with American coal burned in patent ovens have given satisfactory results,—71 to 72 per cent. of good furnace coal, with a residue of 1 to 2 per cent. of small coke and ash.

In Germany two systems of ovens have made rapid progress,—the Otto-Coppée and the Otto-Hoffmann; 6399 of the former and 1759 of the latter had been built up to the close of 1894. Besides these the Germans use a few ovens constructed on the Sennet-Solvay system, which, however, is more in favor in Belgium. In France a fourth type, the Carvès-Seibel, is used, and a fifth type, the Simon-Carvès, has been built to the number of 400. Two or three other systems have been tried on a smaller scale in Europe. In England but little progress has been made in the introduction of the patent ovens, though experimental plants have not been lacking. There seems to be a prejudice against "patent" coke among furnace-men, because it lacks the lightness and luster of the beehive coke. The *Colliery Guardian* says as to this: "It is greatly against England that the pig-iron manufacturers have to pay more for their coke than their competitors in the United States or Germany: but, if their own prejudices have hitherto stood in the way of enabling coke-makers to supply them with cheaper material, they can hardly blame others for what appears to be their own perversity. The Germans have certainly proved that patent-oven coke can be made more cheaply than beehive coke, and they claim to have demonstrated that its quality is not in any way inferior."

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**Speculation in Mines.**

SPEAKING of the revival of speculative interest in mining stocks during the past year or so, and especially in England, the London *Mining Journal* marks the distinction between the two classes of buyers and their different motives. "In the former case we have what may be termed commercial mining, undertaken in the same manner as any other branch of business, and we believe with as good an average prospect of success; and, in the other, speculative mining, in which profit is looked for, not so much from the mine itself, but from operations on the market, which may too often be described as sheer gambling." Perhaps the *Mining Journal* might do well to include a third class,—those who buy to hold for dividends, but who do so without any intelligent understanding of the business, and whose investment is, therefore, a mere trusting to second-hand information, to the credibility of promoters, or to mere luck. This is quite as much "sheer gambling" as buying shares for a rise. But the *Journal's* estimate of the average prospects of legitimate mining, "undertaken in the same manner as any other branch of business,"—that is, with full knowledge of the conditions and some insight into the character of the mining business,—is entirely justifiable.

THE TECHNICAL INDEX—1895.

*Current Leading Articles on Mining and Metallurgy in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

Metallurgy.

*29989. Chinese Development and the British Iron Trade (C G-March 1.) 1600 w.

*30005. Concentration and Cyanide. Editorial (M J-March 2.) 800 w.

30007. Impurities of Commercial Industrial Aluminum. Henri Moissan in Comptes Rendus (A M & I W-March 8.) 600 w.

*30013. Producer Gas as Applied to Foundry Purposes. George T. Prince (I C T-March 1.) 3800 w.

*30032. Furnaces for Roasting Gold-Bearing Ores. Ill. C. G. Warnford Lock, with Discussion (J S A-March 1.) 6400 w.

†30069. Nickel and Nickel Steel. Francis L. Sperry (Tr A M E-March.) 4300 w.

†30073. The Nomenclature of Zinc-Ores. Walter Reuben Ingalls (Tr A M E-March.) 800 w.

†30076. Aluminum-Bronze. Leonard Waldo (Tr A M E-March.) 1700 w.

†30077. A Water-Cooling Apparatus. Carl Henrich (Tr A M E-March.) 2000 w.

†30079. Close Sizing before Jigging. Robert H. Richards. (Discussion.) (Tr A M E-March.) 4500 w.

†30081. Magnesia and Sulphur in Blast Furnace Cinders. Continued Discussion of paper by Mr. Firmstone (Tr A M E-March.) 1500 w.

30087. The Permeability of Mild Steel. Dugald C. Jackson (E W-March 16.) 400 w.

30103. The Crystallization of Steel. Editorial (R G-March 15.) 2200 w.

30117. Pressure on Broach. D. C. Woodward (A M-March 14.) 1000 w.

30121. The Philosophy of Stamp-Milling. T. A. Rickard (E M J-March 16.) 3000 w.

30122. Preparation and Properties of Titanium. Henri Moissan (E M J-March 16.) 800 w.

30141. Sulphuric Acid Making from Gold Ores at Blacksburg, S. C. (M R-March 15.) 700 w.

*30186. The Present Development of the Coke Industry. Anon. (C G-March 8.) 1300 w.

*30218. The Armor-Plate Problem of To-Day. Anon. (I C T-March 8.) 2200 w.

*30258. Electrical Precipitation of Gold.—Criticism on A. Von Gernet's Article (A M S-Feb. 16.) 2000 w.

†30262. The Superiority of Barium Hydroxide Solution As an Absorbent in Carbon Determinations in Steel. James O. Handy (J A C S-April.) 1200 w.

†30264. Note on the Estimation of Iron and Alumina in Phosphates. K. P. McElroy (J A C. S-April.) 900 w.

30286. Gas from Coke Ovens. Dr. Schniewind (Ir Age-March 21.) 4300 w.

30288. The Carnegie Armor Plate Test. Ill. (Ir Age-March 21.) 900 w.

30320. A Water-Cooling Apparatus. Ill. (E N-March 21.) 2000 w.

†30322. Theory of Electro-metallurgy. Francis B. Crocker (S M Q-Jan.) 11000 w.

30332. Sub-classification of Zenogenous Ore Deposits. John B. Ha tings (E M J-March 23 ) 2200 w.

30335. Furnace Dust-Catcher Refuse. William B. Phillips (I T R-March 21.) 600 w.

*30357. Electrolysis of Gold.—Patent of N. S. Keith (Min W-March 16.) 1000 w.

*30384. Blast Furnace Motor Gas. W. H. Booth (E R L-March 15.) 1800 w.

30408.—75 cts. Close Sizing before Jigging. Ill. Robert H. Richards (T Q-Oct. 1894.) 9000 w.

30459. Modern Furnace vs. Cupola Practice. Thomas D. West (A M-March 28.) 3000 w.

30460. The Proposed Restriction of Welsh Tin Plate Production (Ir Age-March 28.) 900 w.

30534. Boiler Steel Requirements. Boiler Maker (Eng-March 30.) 1000 w.

30544. The Semet-Solvay vs. the Otto-Hoffman Ovens. John H. Darby, with Editorial (A M & I W-March 29.) 2500 w.

30558. Jugglery in Testing Cast Iron. Thomas D. West (I T R-March 28.) 2500 w.

*30590. Iron and Brass. J. W. Singer, with Discussion (B-March 28.) 7800 w.

*30608. Dr. Keith's Paper at the I. E. E.—An Abortive Discussion. Desmond G. Fitzgerald (E R L-March 22.) 1700 w.

*30623. The Iron Industry of France.—From the Statistique de l'Industrie Minérale (C G-March 22.) 2800 w.

*30626. The Flue-Dust Condensers of the Freiberg Smelting Works. C. H. Bauer (C G-March 22.) 1400 w.

*30628. The Desulphurization of Liquid Cast Iron. Ch. Walrand (C G-March 22.) 1500 w.

30661. Standard Tests of Iron and Steel.—Report of Com. of Amer. Soc. of Civ. Eng. (Ir Age-April 4 ) 1400 w.

30664. Notes on Northern and Southern Foundry Irons. C. A. Meissner (Ir Age-April 4.) 1200 w.

30689. The Cyanide Process on the Witwatersrand (Transvaal) Gold Fields. M. Eissler (Sc A S-April 6.) 1500 w.

*30703 Nickel Steel: Its Special Value for Armor. W. H. Jaques (E Rev-Feb. 20.) 1500 w.

*30704. A Modern South African Banket Gold Extracting Plant. B. H. Thwaite (E Rev-Feb. 20.) 1300 w.

30738. Design and Construction of Tall Steel Stacks. Ill. (E R-April 6.) 1100 w.

*We supply copies of these articles. See introductory.*

30756. The Desulphurization of Liquid Pig Iron. A. Volthaire (E M J-April 6.) 1100 w.

*30782. The Comparative Metallic and Money Values of Iron Ores. Walter J. May (C G-March 29.) 900 w.

30807. Study of the Physics of Cast Iron. William R. Webster (I T R-April 4.) 500 w.

### Mining.

*29959. Mine Reports and Mine Salting. William McDermott (E Mag-May.) 3000 w.

*29991. Coal Mining in South Africa—Brakpan Colliery. From the South African Mining Journal (C G-March 1.) 3000 w.

*30004. Speculation in Mines. Editorial (M J-March 2.) 900 w.

30022. Slate—Its History and General Utility. George H. Harris (M I T-March 7.) 1400 w.

*30033. Coal Mining Under Sidney Harbor (Tr-March 1.) 1800 w.

30045. A Wonderful Triumph of Engineering Skill.—Jeddo Basin Tunnel (B I S-March 10.) 1800 w.

*30046. A Great Copper Mine—The Tamarack Mine, Lake Superior Peninsula, Mich. Ill. Charles S. Herzig (C E-March.) 2200 w.

†30071. Cinnabar in Texas. William P. Blake (Tr A M E-March.) 2500 w.

†30072. North Carolina Monazite. H. B. C. Nitze (Tr A M E-March.) 800 w.

†30074. The Nickel Mine at Lancaster Gap, Pa., and the Pyrrhotite Deposit at Anthony's Nose on the Hudson. I. F. Kemp. (Discussion) 1500 w.

†30075. The Tin Deposits of Durango, Mexico. Ill. Walter Renton Ingalls (Tr A M E-March.) 5000 w.

†30078. The White Phosphates of Tennessee. Charles Willard Hayes (Tr A M E-March.) 2500 w.

†30080. The Genesis of Ore Deposits.—Continued Discussion of Paper by Bergrath F. Posepny. Joseph Le Conte (Tr A M E-March.) 3500 w.

†30082. Coal Dust as an Explosive Agent.—Continued Discussion of paper by Mr. Glenn (Tr A M E-March.) 3000 w.

†30083. The Dikes and Reefs of Bendigo.—Continued Discussion of paper of T. A. Rickard (Tr A M E-March.) 3000 w.

30138. Mineral and Timber Wealth in West Virginia. A. B. Fleming (M R-March 15.) 2500 w.

30139. The Coal Fields of West Virginia. Jed. Hotchkiss (M R-March 15.) 7500 w.

*30185. Coal in New Caledonia. (Extract.) M. Jeantet (C G-March 8.) 2000 w.

*30187. How Coal Comes to London. C. H. Grinling (C G-March 8.) 800 w.

30217. Copper Mining in the South.—Ducktown, Tenn. (T-March 15.) 2800 w.

*30220. Dundas Coal Fields. Brenton Symons (M J-March 9.) 1000 w.

*30223. Gold in Colorado. A Correspondent (M J-March 9.) 1800 w.

*30225. The Mineral Wealth of Russia and Siberia. Editorial (M J-March 9.) 1500 w.

*30226. The Covadonga Manganese District and Its Mines. J. A. Jones (M J-March 9.) 1700 w.

*30227. Mining in Sonora, Mexico. J. Howard Palmer (M J-March 9.) 2000 w.

30240. Distribution of Phosphorus and System of Sampling at the Pewabic Mine. E. F. Brown, with Discussion (I T R-March 14.) 2200 w.

30241. Open Pit Mining on the Mesabi Range. F. W. Denton (I T R-March 14.) 3400 w.

30246. Natural Gas in California (A M & I W-March 15.) 1000 w.

*30251. Petroleum and Natural Gas. (Abstract.) H. M. Cadell (A M S-Jan. 26.) 2000 w.

*30252. Recent Work at Mount Lyell (Tas.) (A M S-Jan 26.) 1500 w.

*30254. The First Auriferous Drift—In Search of It in the Ballarat Goldfield. Nicholas Reed (A M S-Feb. 2.) 1200 w.

30310 Drainage in Mines. William Nance (M S P-March 16.) 1200 w.

†30325. A Plumbing Method for Steep Shafts. Ill. R. G. Brown (S MQ-Jan.) 700 w.

30334. Ducktown, Tenn., Copper Mining District. Ill. William M. Brewer (E M J-March 23.) 1200 w.

*30346. The Malafolie Colliery, Saint Etienne, Loire, France (C G-March 15.) 1800 w.

*30348. The Use of Explosives in Belgian Collieries. From Report of Victor Watteque (C G-March 15.) 2400 w.

*30393. Slate and Slate Mining. C. Le Neve Foster (M J-March 16.) 800 w.

*30396. Rand Mines as an Investment. Editorial (M J-March 16.) 700 w.

30483. The Greatest Gold Field. Dan De Quille (M S P-March 23.) 2000 w.

30494. A Free School of Mines. Courtenay De Kalb (M R-March 29.) 1000 w.

*30642. Underground Haulage Roads and How to Maintain Them (Abstract). Mr. Halliwell (I C T-March 22.) 2800 w.

*30647. Summaries of Mineral Statistics for 1894. Editorial (M J-March 23.) 2200 w.

*30648. Syndicates. Editorial (M J-March 23.) 1200 w.

30657. Gold Mining in Georgia. Anon. (T-April 1.) 2400 w.

30659. Electricity for Mining Plants. The Various Uses to Which It Is Applied.—The Cost. Anon. (T-April 1.) 2300 w.

30685. An Ohio Natural Gas Well. Ill (ScA-April 6.) 600 w.

†30694. Corundum (I E-March 2.) 800 w.

*30724. Prospectors' Tools.—Description of Tools Used and How to Sharpen and Temper Them. Ill. Arthur Lakes (C E-April.) 2800 w.

*30727. Compressed Air in Mining Operations. Charles C. Hanson (C E-April.) 1300 w.

*30729. Geologic Conditions of Economic Mining in Iowa. H. Foster Bain (C E-April.) 2800 w.

*30781. The Mineral Fuels of Chili and Their Preparation. Henri Babinski (C G-March 29.) 4800 w.

*30783. Working Coal Mines Out of Bounds (C G-March 29.) 4000 w.

*30784. The Mines of Bosnia and Herzegovina. From Report by Consul General Freeman (C G-March 29.) 1700 w.

*30785. The Haematite Ores of the West Coast (C G-March 29.) 1100 w.

*30786. Metal Mining (Extract). J. H. Collins (C G-March 29.) 4000 w.

30808. Steel Structures at Mines. Harry J. Lewis (I T R-April 4.) 1800 w.

Miscellany.

*30347. The Wages Cost of Producing Coal. Anon. (C G-March 15.) 900 w.

*30349. Contracts Relating to the Sale and Delivery of Coal (C G-March 15.) 3500 w.

*30395. The Production of the Precious Metals. Editorial (M J-March 16.) 1800 w.

30525. Sixty-eighth Meeting of the American Institute of Mining Engineers, Florida, with Abstracts of Papers and Editorial (E M J-March 30.) 7000 w.

30577. The Health of Miners (A S-March 30.) 800 w.

*30625. A Walk in a Coal Forest. J. William Dawson (C G-March 22.) 2500 w.

30697. Southern Mineral Wealth—Description of Exhibit to Be Made at Atlanta (M R-April 5.) 2500 w.

30754. Compressed Air for Pumping. Frank Richards (E M J-April 6.) 1900 w.

30755. Silver Mining and Smelting in China (E M J-April 6.) 1500 w.

*30793. Diamond Washing and Concentration. Editorial (M J-March 30.) 1800 w.

Serials.

20413. Mining Methods. Ill. (C E-Began March, 1894—14 parts to date—30 cts. each).

20414. Geology of Coal. Ill. (C E-Began March, 1894—14 parts to date—30 cts. each).

20415. Mining Machinery. Ill. (C E-Began March, 1894—14 parts to date—30 cts. each).

20416. Chemistry of Mining. Ill. (C E-Began March, 1894—14 parts to date—30 cts. each).

21814. Plate Moulding. J. Horner (P Eng-Began April 27, 1894—15 parts to date—30 cts. each).

22586. The Mineral Hydrocarbons. Henry G. Hanks (M S P-Began June 2—25 parts to date—15 cts. each).

22710. Science for Ironmongers (Irm-Began June 2, 1894—18 parts to date—30 cts. each).

24036. Metal Mining.—Underhand and Overhead Stoping Systems. Ill. Albert Williams, Jr. (C E-Began Aug.—5 parts to date—30 cts. each).

27329. Coal-Mining Economy Up to Date (I C T-Began Nov. 23—11 parts to date—30 cts. each).

27450. Cupola Tuyeres. Edward Kirk (Met W-Began Dec. 8, 1894—6 parts to date—15 cts. each).

28786. The Mineral Wealth of Siberia (M J-Began Jan. 19—10 parts to date—30 cts. each).

29468. The Cyanide Process.—Its Practical Application and Economical Results. A. Scheidel (M J-Began Feb. 9—7 parts to date—30 cts. each).

29599. Mining in Spain (Asturias). Anon. (M J-Began Feb. 16—2 parts to date—30 cts. each).

29753. The Sampling and Measurement of Ore Bodies in Mine Examination. Edmund B. Kirby (E M J-Began March 2—Ended March 16—3 parts—15 cts. each).

29815. Geology of the South-East Portion of the Congo Basin and the Metalliferous Deposits of Katanza. J. Cornet (C G-Began Feb. 22—Ended March 22—5 parts—30 cts. each).

29817. Recent Developments in Coal Mining in Japan (Eng L-Began Feb. 22—Ended March 1—2 parts—30 cts. each).

29939. Pocket Hunting in California. W. H. Storms (M S P-Began March 2—2 parts to date—15 cts. each).

29988. A Review of the Coal Dust Question. James Ashworth (C G-Began March 1—3 parts to date—30 cts. each).

30009. Down in a Belgian Coal Mine. B. Lippens (C Eng-Began March—1 part to date—15 cts).

30047. Prospecting.—Where and How to Find Gold and Silver Veins and Deposits. Ill. Arthur Lakes (C E-Began March—1 part to date—30 cts).

30049. Mine Surveying.—Latest American Ideas and Most Approved Practice. Edward B. Durham (C E-Began March—2 parts to date—30 cts. each).

30214. Modern Coke Making. William Bowron (T-Began March 15—2 parts to date—15 cts. each).

30250. Refractory Gold Ores of Queensland. E. A. Weinberg (A M S-Began Jan. 26—3 parts to date—30 cts. each).

30394. Auriferous Resources of Victoria. H. Armytage (M J-Began March 16—Ended March 23—2 parts—30 cts. each).

30461. The History of Iron. Notes from Dr. Ludwig Beck (Ir Age-Began March 28—2 parts to date—15 cts. each).

30484. Characteristic Features of California Gold Quartz Veins. Waldemar Lindgren (M S P-Began March 23—1 part to date—15 cts.)

30791. Gold Mining in Wales. Anon. (M J-Began March 30—1 part to date—30 cts.)

30815. Furnaces for Roasting Gold-Bearing Ores. Ill. C. G. Warnford Lock (I C T-Began March 29—1 part to date—30 cts).

# MUNICIPAL ENGINEERING

### Depth of Sand in Filtration.

GRACE C. FRANKLAND, joint author with Prof. Percy Frankland, St. Andrew's University, Dundee, Scotland, of "Micro-Organisms in Water," contributes important observations relating to sand filtration to *Engineering News* (March 14). Quoting the researches of Dr. Percy Frankland, and later those of Reinsch, the author points out that the depth of sand filtration is a potent factor in the efficiency of this means of removing bacteria. The experiments of Reinsch are particularly conclusive as establishing this proposition. "To test this point in more detail, he (Reinsch) drew off the water as it passed through the sand-bed at various depths, commencing immediately beneath the layer of slime at depths varying from 60 to 920 mm. (2.36 to 36.2 in.) One example is sufficient to indicate the nature of the results obtained. The untreated water contained 36,320 microbes in 1 cu. cm. After passing the layer of slime, there were 1876 per cu. cm. found, whilst, after traversing the whole column of sand, there were only 44 in 1 cu. cm. Thus, although after passing through the layer of slime a very large reduction is effected in the microbes present, yet the filtrate still contains bacteria in numbers altogether inadmissible in a properly-filtered water. These results are of importance, as there is a tendency at the present time to attribute too exclusive an importance to the slime and ignore the depth of sand material. Reinsch does not mention the investigations made during the past years at the Zurich water-works, where it was also found that to reduce the depth of sand was to damage the filtrate, and that, in consequence, the layer of sand should never be allowed to sink below 30 cm. (practically 1 ft.). Reinsch, in his conclusions, states that the column of sand to produce a good filtrate, should never be less than from 40 to 60 cm. (15 to 24 in.) deep. In order to encourage the formation of surface slime, the filters at Altona, after the water is run on, are left undisturbed for 12 hours, and Reinsch states that the neglect of this simple precaution exercised an important influence on the filtrate. These investigations were carried on at the Altona water-works over a period of 18 months, during which time daily samples were bacteriologically examined from each individual filter-bed. In this manner the working of each filter was under constant surveillance, and any abnormally high numbers in the microbes present in any filtrate was at once noted and its cause investigated, thus enabling a bad filtrate to be at once rejected before the whole supply had become deteriorated or endangered by its admixture."

The author adds that the recrudescence of cholera at Altona was ascribed by Koch to the insufficient working of one of the sand filter-beds, this fact not being detected till the whole water-supply had become infected. An important feature of sand-filters insisted upon by Dr. Reinsch is the provision of facilities for sampling the water at different depths, which, he states, can now be done only with extreme difficulty in many of the older beds.

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### Making and Paying for Parks.

A NEW journal of practical information for municipalities and counties and for those whose business comprises commercial transactions with municipal and county officials is published monthly at Buffalo, and has reached its sixth number. It is a nicely-printed, bright-looking paper and it is named *The Municipality and County*. Sampling its contents, we find an unsigned article, "Making and Paying for Parks," which gives information about the parks in some fifty or more cities of the United States. "Just as the industrial revolution of the past 50 or 75 years has centralized humanity into large cities, so we must now gather the beauties, advantages, and blessings of inanimate na-

ture into small portions of those cities. A park, then, must be something that will furnish to these condensations of population (in a proportionately condensed manner) the essentials of life in the country,—*i. e.*, fresh air, trees, grass, and flowers,—and the greater this density of population, the more urgent the necessity for the parks."

New York is spoken of as a city in which the condition calling for parks exists preëminently. "A sub-committee of the 'Committee of Seventy' reports that in one section there are within a radius of half a mile 250,000 people who live out of sight and out of reach of a green spot. In one block there are 2628 persons on an area of 1¼ acres, being at the rate of 1526 persons to an acre. If residents of cities where it is usual for one small house to occupy say 1-5 of an acre, thus giving say five families or perhaps twenty-five persons to the acre, can grasp the force of these figures, they will realize what we mean by saying that in New York is to be found the condition which reaches an ideal point of necessity for parks,—*viz.*, the presence of a multitude of people, and the absence of open country."

The most valuable part of this article is, however, a summary of information obtained during the past winter in reply to a circular letter of Capt. G. J. Fieberger, acting for the park commissioners of Washington, D. C. The following queries were put to and answered by officials of fifty-one cities. From the replies it is found that forty-five cities do not assess adjacent or abutting property,—to wit, Albany, Alleghany (Pa.), Atlanta, Baltimore, Bridgeport, Buffalo, Cleveland, Cincinnati, Davenport (Ia.), Denver, Des Moines, Detroit, Elizabeth (N. J.), Erie (Pa.), Evansville (Ind.), Los Angeles, Louisville, Lowell, Lynn, Manchester (N. H.), Memphis, Mobile, Nashville, Newark, New Bedford, New Haven, Oakland, Omaha, Pittsburg, Richmond (Va.), San Francisco, Scranton, Springfield (Mass.), St. Joseph, St. Louis, Syracuse, Toledo, Trenton, Troy, Utica, Wilmington (Del.), and Worcester.

Cities which do assess adjacent property are: Boston, Brooklyn, Cambridge, Minneapolis, Kansas City (Mo.), and St. Paul, Minn. Boston has the curious system of assessing lands around parks within distances varying from 200 ft. to 600 ft. In Brooklyn Prospect Park "was made a charge against the twelve wards which composed the old city." Kansas City has the system of submitting to a jury the determination of what assessments against property adjacent to parks are equitable. St. Paul assesses 60 per cent. against adjacent property, the distance from the parks wherein such assessments are made depending upon circumstances. In Denver an attempt is on foot to divide the city into park districts. Baltimore exacts 9 per cent. of the gross receipts of street-railways for park purposes. These facts indicate entire lack of uniformity in methods of raising money for parks; but it is added that "mayors and park commissioners are getting together," and it is hoped the "view of the entire field" supplied in this article "will furnish a ground-plan upon which officials can build a more uniform system."

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**Purifying Sewage and Water by Aeration.**

A METHOD of purification claimed to be effective, not only for sewage, but for water also, has recently been experimented with at St. Louis. An account of the method, written by Mr. J. H. Curtis, was printed in *Engineering News* (Feb. 27). Mr. Curtis, speaking of the experiments with sand filtration carried out by the Massachusetts State Board of Health, says that "sand is only a means to an end," and asserts in substance that it is the aeration which takes place during filtration that is the real agent in effecting the desired purification. *Engineering News*, having submitted the proofs of the article by Mr. Curtis to Mr. Geo. W. Fuller, biologist-in-charge of the Lawrence Experiment Station of the Massachusetts State Board of Health, also prints a letter from Mr. Fuller, quoted below. Mr. Curtis describes the St. Louis experiment as follows:

"Aeration was employed, in which the liquid to be treated is absolutely disintegrated or reduced to spray. At the same instant of time, and in juxtaposition with the

liquid spray, there must be an atom of disintegrated air. What is the result? Organic matter accompanying the liquid is at once seized by the different constituents of the air, and there are produced pure water and harmless inorganic compounds. How performed? By a screen floor, say, with pepper-box perforations, over which is a layer of coarse river sand, somewhere below another layer of sand, leaving an air chamber between the two. Then, to duplicate nature, cause a rain storm of the liquid to be purified by forcing air into the chamber of a little less pressure than what is sufficient to sustain the weight of the liquid in the tank. These drops, falling on the fine sand, which must be kept unsubmerged, are then and there purified. The perfect disintegration of air and liquid is mechanically performed by the sieve action of the top filament (?) of sand. In this way from 6,000,000 to 15,000,000 gallons of liquid can be treated per acre per day. The lower air-screen is self-purifying, and can be made of any necessary depth to perform the work. In cases of very strong sewage or very much polluted water, additional sand screens have been suspended in the air chamber, grading the sand to a finer quality from the top screen downward. This method disposes of the sludge question. Also aspirators have been attached to the perforated floor, discharging air to the surface of the primary screen, from which the excess air is returned to the chamber by the descending liquid. The aspirators were used with fine gravel. They serve to agitate the surface and prevent clogging."

Some remarks as to the necessary qualities of the sand and some special details of the apparatus are omitted, since, if Mr. Fuller's opinion is authoritative, the whole scheme is fallacious. Mr. Fuller writes:

"The reference by Mr. Curtis to the reports of the Massachusetts State Board of Health on the purification of sewage by intermittent filtration where artificial aeration is used for the removal of air in the filters shows such a complete misapprehension of the process of purification by bacterial action, as well as misconception of the results of our work, that it is difficult to comment on the statements in his letter. He has entirely missed the idea of purification in the series of intermittent sewage filters Nos. 12A, 15B and 16B, which have been described in our reports for 1892 and 1893. It seems to me unnecessary to comment on his scheme until he has some facts to give with regard to the bacterial and organic purification of water and sewage by his system."

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### More About Acetylene.

THIS illuminant was made the subject of discussion at the twenty-fifth annual meeting of the New England Association of Gas Engineers, held in Boston February 13 and 14, the proceedings being printed in *American Gas-Light Journal* (March 11). Perhaps it would be as accurate to say that the advantages of calcium carbid as a gas-making material was the matter under discussion, since the value of acetylene (obtained from calcium carbid by treatment of the latter with water) as an enricher was admitted by all who took part in the debate. The facts brought out may be summarized as follows:

Acetylene is one of the illuminating principles in both coal-gas and water-gas, the amount of this substance present in commercial illuminating gas being less than 1 per cent. Gaseous acetylene has a specific gravity of 0.91, air being the standard of comparison. Water absorbs about its own volume of the gas. At a temperature of 32° F. it is reduced to a liquid by a pressure of about 50 atmospheres. The specific gravity of the liquid so produced is 0.4, water being the standard of comparison. Thus, while the gaseous acetylene is nearly as heavy as air, liquid acetylene is less than half as heavy as water, bulk for bulk. While the combustion of 1 cu. ft. of coal-gas or water-gas gives from 500 to 600 British thermal units, the combustion of gaseous acetylene produces 1500.

One of the speakers present, Mr. Hinman, remarking upon the claim that a light of 240 c. p. is produced by a consumption of 5 ft. of acetylene gas per hour, thought this was possibly too large an estimate. One objection to the use of acetylene as an illuminant, stated by this speaker, is that it

forms a compound with copper and attacks all brass fittings, the substance thus formed being explosive. Should it come into extensive use, this will probably necessitate a modification of gas fittings at present in vogue, and some material not containing copper will be employed for fixtures. Another objection is that its illuminating power, compared to its heating power, is so large that, though it might be economical for lighting, it could not be used economically for heating, the latter being an increasing and important application of gas for domestic purposes.

An interesting illustration of the formation of an explosive substance by the action of acetylene on copper was presented by Dr. Wilkinson. He said that "in the old gas works a good deal of copper tubing was used, and it was noticed that there was deposited inside of the copper tubing a compound which, when it was struck by a hammer, would explode. After that, people were very careful in handling the old copper tubing from gas works, for it would explode almost like gunpowder, when struck or when heated. Acetylene also forms an explosive compound with silver. These are all well-known explosive compounds. But in our ordinary works I do not think we need anticipate any trouble from that source, as the small amount of copper that we have in our stopcocks would not be sufficient to cause any difficulty. The use of copper piping about our works is a thing of the past. So in that respect I do not think we have anything to fear."

Dr. Wilkinson also stated that the promoters of acetylene as an illuminant expect to make it cheaply enough to render it commercially practicable. "They say, for instance, there is a great water power at Niagara Falls; they may use that at night, and then for 6 or 8 hours every day the power is idle; wherefore, if we can make the carbid during the day, we can possibly make it very cheaply. As regards its competing with naphtha, you will see that, if it is $5 or $10 per ton, you can compare that with cannel coal at $10 per ton, from which you get about the same quantity of gas. Of course cannel coal will not enrich in proportion anything like what this substance would. As an enricher for water-gas it has been a disappointment to all of us. With 10 per cent. of acetylene in water-gas the gas burns blue; 20 per cent. gives you a little better light; while 40 per cent. gives you a beautiful light. There you see that it is of no use." While this material is so inefficient an enricher for water-gas, an addition of 2 or 3 per cent. to coal-gas, the speaker said, raises the latter from 16 to 20 c. p., and at the same time produces a clear white light.

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**European Reservoirs for Water Supply.**

IN "Notes on European Water Supply," Mr. Allen Hazen, of the Boston Society of Civil Engineers (*Journal of Engineering Societies*, February), among a variety of interesting particulars, says that in constructing water-works provision is made nowhere in Europe for a supply of one-half, and frequently for a supply of not more than one-fourth, the quantity per head that is "considered necessary for American communities. The causes of this difference are not altogether clear. In some instances the smallness of the European consumption may, in a measure, be attributable to a smaller proportion of water-closets, or to the fact that the entire population is not provided with flowing water in private apartments. But, after making all possible allowance, there is still a wide discrepancy which cannot be accounted for by the greater comforts or cleanliness of the American cities. Fire protection in Europe is upon a radically different basis from that in America. In all European capitals the construction of other than fireproof buildings is strictly prohibited, and fires, as we understand them in America, can hardly be said to exist. In Berlin, during the past year, the quantity of water which supplied all the necessities of the fire department for extinguishing fires and other purposes was less than three thousand gallons daily, and in no other German city, except Hamburg, was so large a quantity required." Water meters are said to be much more generally used in European than in American cities, and this fact undoubtedly prevents waste.

### Sewerage in Foreign Cities.

"SEWERAGE IN FOREIGN CITIES" takes up about 100 pages of "Consular Reports" for February, 1895. At the request of the Sanitary Board of Savannah the State Department in July, 1894, sent a circular to the consular offices in the principal cities of Europe, requesting information on certain specified points in relation to the sewerage systems of those cities. Replies were received from Amsterdam, Berlin, Bordeaux, Bradford, Bremen, Brussels, Cardiff, Constantinople, Copenhagen, Dublin, Edinburgh and Leith, Florence, Frankfort, Glasgow, Hamburg, Havre, Leeds, Liverpool, Lyons, Manchester, Marseilles, Munich, Rome, St. Petersburg, Stettin, Stockholm, Trieste and Vienna, and are included in the publication mentioned above. Some of the replies—says *Engineering News*—were prepared with care from official reports and contain recent information, in some cases, regarding a number of European sewerage systems, which is not available elsewhere, and may be interesting to some, although written from a popular rather than an engineering standpoint. For copies of the issue of "Consular Reports" containing this matter the Bureau of Statistics, Department of State, Washington, D. C., may be addressed.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Municipal Engineering in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

### Gas Supply.

30006. Carbide of Calcium.—Its Advantages as a Gas Making Material and as an Enricher.—Discussion at Meeting of New Eng. Asso. of Gas Eng. (A G L J-March 11.) 3500 w.

30008. Welsbach Street Lighting in Budapest. Isador Bernauer (Am & I W-March 8.) 400 w.

*30035. Life in the Far East. From a Gas Manager's Wife's Point of View. Mrs. A. Smith (G W-March 2.) 3800 w.

30060. Gas.—Its Production and Relation to Foundries. Arthur Kitson (Ir Age-March 14.) 2400 w.

30145. The Key to the Welsbach Problem. Charles G. Burton (E E-March.) 1700 w.

*30212. Relative Cost of Gas and Electric Light Works (J G L-March 5.) 2000 w.

*30289. Gas Workers and Old-Age Pensions. Anon. (J G L-March 12.) 2200 w.

*30290. Carburetting by Benzol. Ill. (J G L-March 12.) 1000 w.

30400. The Best Way to Burn Gas for Lighting Purposes. C. R. Bellamy (A G L J-March 25.) 3300 w.

30401. Carbide of Calcium. Henry L. Doherty (A G L J-March 25.) 1500 w.

30402. Changing the Arrangement of a Retort House and the Practical Results Derived Therefrom. A. F. Nash (A G L J-March 25.) 1200 w.

30403. Prepayment Gas Meters. John D. Mc Ilhenny (A G L J-March 25.) 3200 w.

30404. Cannel Coal as an Enricher. Graham Macfarlane (A G L J-March 25.) 1300 w.

*30413. On the Manufacture of Acetylene. Anon. (G W-March 16.) 1800 w.

30471. Acetylene Apparatus. T. O'Conor Sloane (Sc A-March 30.) 700 w.

30474. Acetylene for Gas Purposes. Dr. Wilkinson (Sc A S-March 30.) 1500 w.

30536. Soft-Coal Water Gas. W. S. Bowen (A G L J-April 1.) 2800 w.

30537. Carbide of Calcium. W. W. Goodwin (A G L J-April 1.) 3500 w.

30545. Comparative Measurement of Different Incandescent Burners. W. Wedding (A M & I W-March 29.) 1200 w.

*30579. The Distribution of Gas (J G L-March 19.) 1900 w.

*30580. Gaseous Fuel in the Retort-House. Ill. T. S. Cleminshaw (J G L-March 19.) 2300 w.

*30581. Acetylene as an Illuminating Gas.—A German View of the Subject (J G L-March 19.) 800 w.

*30606. The Real and Alleged Defects of Flueless Gas Stoves. Thomas Fletcher (G W-March 23.) 3500 w.

*30701. Explosions in Electric Light Culverts. F. C. S. (J G L-March 26.) 1000 w.

30753. Is This a Possible Rival of Electricity for Illumination? C. C. Haskins (W E-April 6.) 1500 w.

*30789. The Cause of Luminosity in the Flames of Hydro Carbon Gases. Vivian B. Lewes, with Editorial (G W-March 30.) 9000 w.

30800. Discussion of Mr. Nash's Paper—"Changing the Arrangement of a Retort House, and the Practical Benefits Derived Therefrom" (A G L J-April 8.) 3000 w.

30801. Discussion of Mr. Bowen's Paper—"Soft Coal Water Gas" (A G L J-April 8.) 1200 w.

30802. Discussion of Mr. McIlhenny's paper "Prepayment Gas Meters" (A G L J-April 8.) 1200 w.

30803. Discussion Concerning Incandescent Burners (A G L J-April 8.) 5000 w.

### Sewerage.

29974. Sewage Disposal Works, New

Rochelle, N. Y. Ill. (E R–March 9.) 1400 w.

### Streets and Pavements.

30065. MacAdam's Method of Road Building. From the St. James Gazette (E & C–March 8.) 1000 w.

†30326. Vitrified Brick for Street Pavements. T. W. Gibson (S M Q–Jan.) 11200 w.

*30632. Injurious Manipulation of Asphalt. F. A. Hetherington (P–April.) 1200 w.

*30633. Some Tests of Paving Brick. James W. Reed (P–April.) 1300 w.

*30636. Paving Brick in Ontario.—From Report of the Bureau of Mines of Ontario (P–April.) 1500 w.

30709. The Perkins Surface Heater for Repairing Asphalt Pavements. Ill. (E N–April 4.) 1400 w.

### Water Supply.

29973. Submerged Cast Iron Pipe Line, Portland, Ore. (Abstract.) Franklin Riffle and Albert S. Riffle. Published in T. C. E. (E R–March 9.) 1800 w.

*29986. London Water Supply. Editorial (E–March 1.) 4600 w.

30106. Auxiliary Supply of the Water-Works of Addison, N. Y. Ill. H. F. Labelle (E N–March 14.) 800 w.

30109. Depth of Sand in Filter Beds Necessary to Remove Bacteria. Grace C. Frankland (E N–March 14.) 700 w.

30130. New Water Works and Lighting Plant, Winchester, Va. Ill. (E R–March 16.) 1300 w.

*30191. Floods and Frost. Anon. (Eng L–March 8.) 2400 w.

*30193. Official Reports on the London Water Supply. Editorial (Eng L–March 8.) 1900 w.

*30292. Notes on European Water Supplies. Allen Hazen (J A E S–Feb.) 7000 w.

*30293. The Lake Vyrnwy Water Supply for Liverpool. Thomas M. Drown (J A E S–Feb.) 1200 w.

30359. The Oberlin, O., Water Tower. Ill. (E R–March 23.) 500 w.

*30368. Frost and Water Supply. Editorial (Eng L–March 15.) 1900 w.

30507. Proposals for a New Water Supply for Jersey City (E N–March 28.) 700 w.

30521. Gas Engines for Water Pumping. Ill. (E R–March 30.) 2700 w.

*30594. The Water Supply of Belfast. Ill. Hary Wimborne (Eng L–March 22.) 2800 w.

30598.—75 cts. Eternal Vigilance, the Price of Good Water. G. F. Chace (J N E W–March.) 1700 w.

30599.—75 cts. The Capacity of Steam Fire Engines, Hydrants and Hose. Dexter Brackett (J N E W–March.) 2500 w.

30600.—75 cts. A Few Examples of High Grade Pumping Engines. Ill. E. D. Leavitt (J N E W–March.) 7400 w.

†30631. The Long Island Water Basin.—Brooklyn's Reservoir. A. N. Bell (San–April.) 1400 w.

†30651. Artesian Water in Western Queensland. (Abstract.) R. L. Jack, with Editorial. (Australasian Pastoralists' Review–Feb. 15.) 7000 w.

†30693. Raj. Rajeswari Water Works, Nasirabad, Mymensingh. Ill. (I E–March 2.) 600 w.

30717. Dam No. 5 for the Additional Water Supply of Boston. Ill. (E N–April 4.) 400 w.

30735. Water Meter Experience in Detroit. (E R–April 6.) 1400 w.

30737. Forests and Water Supply. (Extract.) John Birkinbine (E R–April 6.) 1300 w.

### Miscellany.

*29960. Parks. Parkways and Pleasure Grounds. Frederick Law Olmsted (E Mag–May.) 3000 w.

30146. The Science of City Government.—Review of book by Albert Shaw. Fred De Land (E E–March.) 2200 w.

*30201. Making and Paying for Parks Ill. Anon. (Municipality and County–March.) 2000 w.

*30373. The World's Debt to Modern Sanitary Science. John S. Billings (Ch–April.) 3500 w.

30412. The Work of Women in Village Improvement. Editorial (G & F–March 27.) 1000 w.

30506. The Arnold System of Garbage Utilization at Boston. Ill. (E N–March 28.) 2500 w.

†30629. Domestic Garbage Disposal.—The Household Carbonizer. Ill. W. F. Morse (San–April ) 1300 w.

†30630. Stable Manure and Manure Disposal in New York. Report of Committee (San–April.) 5500 w.

*30634. How to Prevent Electrolysis of Gas and Water Pipes. Udo Hesse (P–April.) 1500 w.

*30635. The Duties of a City Engineer. Horace Andrews (P–April.) 3200 w.

†30670. San Francisco and the Civic Awakening. Adeline Knapp (A–April.) 3500 w.

30715. The St. Louis System of Controlling Municipal Engineering Work (E N–April 4.) 2700 w.

### Serials.

20466. Details of Modern Water Works Construction. Ill. Wolcott C. Foster (S M Q–Began Jan. 1894—3 parts to date—45 cts. each).

28265. Frontinus on the Water Supply of Rome, A. D. 97 (E R–Began Jan. 5—5 parts to date—15 cts. each).

30134. Municipal Responsibility for Damage from Fire Apparatus. Andrew J. Sanford (F W–Began March 16—2 parts to date—15 cts. each).

30399. Studies in Carbide of Calcium. M. P. Wood (A G L J–Began March 25—Ended April 1—2 parts—15 cts. each).

# RAILROADING

**Hardie's Compound Air Car Motor.**

FROM 1877 to 1881 two accomplished Scotch engineers (one of whom died shortly after the period named) were in this country designing and putting into operation a compressed-air motor for street railways. The result of their efforts was a motor which ran with ease the distance from Sixty-ninth street to City Hall, New York, and return,—about 10 miles. The writer of this review rode from City Hall to Sixty-ninth street on one of the first trial trips. There were some imperfections in the motor as then constructed, but in the main it embodied the features of a good machine. It seemed to need nothing but the application of lessons to be learned only by experience to render its operation satisfactory in all respects. This was one of a number of pioneer efforts made about that time to supply a motor for street-car traffic that could take the place of animal traction. One of the two engineers who designed this motor, Mr. Robert Hardie, has been at Rome, N. Y., during the past year, engaged in designing a new compressed-air street-car motor.

These inventors had the misfortune, in the first instance, of being ahead of the age. The necessity for other motors than horses or mules for moving street cars has since become so pronounced, and the means for meeting the demand by electric and cable propulsion have so completely proved the feasibility of the substitution, that horse cars have almost disappeared. Neither cable traction or electric traction are, however, satisfactory in all respects. The period of transition is still on, and the present is, perhaps, as good a time as will ever come to introduce a good street-car motor. Most engineers who know Mr. Hardie personally will feel confident that, if there exist in compressed air the possibilities of a good car-motor, his experience and knowledge render him just the man to produce it. And we think few who have had extensive experience with compressed air as a motive power in other machines will doubt the possibilities. At any rate Mr. Hardie has, we understand, secured a substantial backing, and has constructed and brought to trial a promising motor.

The *Scientific American* (March 16) gives an account of the trial recently made at Rome, N. Y. "The trial was made on the 800 ft. of rough track in the yard of the works, with Engineer Williams at the lever. The car started out with 1800 lbs. of air pressure to the square inch and a temperature of 310 degrees on its hot-water tank, which is used to great advantage in heating the air before it passes at reduced pressure to the engine cylinders. A valve constructed for the purpose reduces the pressure of the stored air to 140 or 150 lbs., and this is the working pressure, or the pressure at which the air enters the engine cylinders. The motor starts gently, runs smoothly at a rapid rate, and stops by air brake without jerk or jar. It was run back and forth repeatedly for upward of forty trips, and the test showed that under the conditions applied the motor would run 12 miles from one charging of compressed air, and make seventy stops.

"The method of recharging the storage cylinders with compressed air was shown. It is a very simple operation, and, with the flexible couplings contemplated for the purpose, the recharging of a car with power need not occupy more than a minute or two. The same is true as to recharging with hot water, and the two can be done at the same time. The temperature of the hot-water tank, covered with asbestos, on the occasion of the trial, was reduced from 310° F. to about 200° in one working hour. Under more favorable circumstances, especially in summer, this reduction would be much less,—probably not more than half as much.

"The Hardie motor and car are hung on elliptic springs, and the ease with which the car passes over wide joints, frogs, or

imperfections in the track is something admirable. This very important feature attracted the attention and favorable comment of the inspecting visitors from the East, all of whom know too well the terrible pounding that the trolley car gives the railroad track, because, like the lumber wagon, it is absolutely without springs. In this respect the Hardie motor indicates a sure and great saving in wear of rails and cars, while affording the utmost ease to passengers riding."

The main features of the motor are the storage of air under high pressure in tubular tanks which deliver their air to compound engines having reversing valve-gear. The air is reheated during its passage to the engine cylinders. The storage tanks (analogues of the steam boiler of a locomotive) are filled from a tank of compressed air at stations, the stationary tank being supplied constantly by a powerful air compressor.

The trial appears to have satisfied men interested in car-propulsion that the new motor is a good one. The *Scientific American* says, on the authority of the Rome *Daily Sentinel*, that, as the results of the trial, an order was given "for the construction of six to ten of the motors to be used on eastern lines. The order is upon certain conditions, one of which is the introduction of Pintsch gas light into the cars. This, Mr. Hardie says, can easily be done, and other mechanical requirements can easily be met." The losses between prime motor and delivery of power to the car-motors are claimed to be less in this system of propulsion than in either cable or electric traction.

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### Railroad Discipline.

In connection with the able papers by W. H. Caniff ("Relations of the Railway to its Employees") and Cy Warman ("Relations of the Employee to the Railroad") published in our March number, another paper, in line with these, by Mr. F. G. Darlington, superintendent of the Pittsburgh, Cincinnati, Chicago, and St. Louis Railway (read by the author at the meeting of the Central Association of Railroad Officers in Columbus, Ohio, Feb. 19), is timely. The paper is of a practical character, dealing with a system of discipline now in force on the Indianapolis division of the above-named railway. It is stated that this system is a modification of the disciplinary system in use on the Fall Brook Railway.

The distinguishing and underlying principle of the system is that of justice to both the company and the men, and to this end records are kept, which show not merely neglect, but also meritorious performance of duty. Mr. Darlington calls this a system of "debits and credits," which affords every man "a true record of his service. Every neglect of duty, instruction, etc., is promptly investigated by the head of the department concerned. Most cases involve the employees of more than one department, and therefore require a joint action by two or more officers. If the case is of a trivial nature, and the facts clear, the officer or officers who make the investigation present the facts (in writing) to the superintendent, and suggest the extent of the discipline. If the examination of the offender's previous record does not show reasons for increasing or diminishing the extent of discipline, the suggestion is approved by the superintendent, and a bulletin is prepared. All cases, except those of a trivial nature, are personally investigated by the superintendent, with the assistance of the head of the department in which the person is employed. If the case involves enginemen, conductors, and questions of train movement or orders, the chief train dispatcher is present and assists in the examination of witnesses; also the road foreman of engines, and the trainmasters. The examinations are recorded by a stenographer. After a case has been investigated, discussed, and the discipline decided, a bulletin is prepared under the direction of the superintendent, containing a concise summary of the facts and discipline imposed. A duplicate copy of the bulletin is forwarded to each officer in charge of a bulletin case, a copy is sent (under personal cover) to the employee disciplined, and record is made in the record book. All papers, reports, etc., of each case are filed for future reference.

The record book is indexed by name; each employee has two opposite pages, so that any person may examine his own record without seeing that of any other employee."

Much time and labor have been involved in carrying this system into regular operation. The preparation of the bulletins necessitates much care. The same may be said of the records. Gross inaccuracy would, of course, render the system entirely worthless. The advantages, however, as stated by Mr. Darlington in the following quotation, would seem to compensate a good deal of effort.

"(1) To avoid loss of time and the consequent possible suffering to those who may be dependent upon the person disciplined. Loss of earnings thus prevented may mean the reform and improvement of many who would, if suspended, develop habits inconsistent with their duties. (2) That all may become acquainted with every case for which discipline is imposed, and learn the lesson from failure of others. (3) The steady employment, which reduces the number of extra men to a minimum, and so avoids the dangers incident to the use of inexperienced persons. (4) By placing the facts before all concerned the evils of misrepresentation are eliminated. (5) Inaccuracy of record is prevented, because any mistake will be promptly reported by those concerned. (6) The necessity for more thorough and systematic care in making investigations leads to a closer relationship between the officers and employees,—a condition which produces coöperation for the best interests of the company.

"The bulletin is a terse form of the record. The form of bulletin is such as to reduce to a minimum the opportunity for employees to discover the name of the person disciplined, the object of the bulletins being to caution all who might commit a similar error. There is no advantage in advertising the names of those who receive the discipline. By furnishing each person disciplined a copy of the bulletin of their case, and by their knowledge of the record made, the effect is better than to humiliate by enabling others to know names. After a bulletin has remained in the case 10 days, it is removed and pasted in the gummed file book. The bulletins are consecutively numbered. The file of bulletins at the headquarters of each bulletin-case enables the employees to examine or study all cases. Bulletin cases are located with the idea that they will be used exclusively by the employees of the Indianapolis Division. Whenever agents, operators, section men, shop employees, and others are disciplined, a copy of the bulletin is sent to each person interested who may not have access to the bulletin-case."

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### Street-Railway Wheel-Treads and Flanges.

THE questions whether a standard for street-railway car-wheels is desirable, whether practicable, if desirable, and, if both desirable and practicable what it should be, have been presented for serial discussion in the *Street Railway Review* (Feb.). In this series of papers will be presented the views of the principal street-railway companies in the United States. It appears that very great diversity exists in practice as regards flanges and treads, and that the adoption of a uniform standard would ultimately result in cheaper wheels. It is likely that the discussion will elicit much information as to the reasons for the existing diversity.

"One man wants a thin, shallow flange, because he is operating on a grooved rail. How many roads in this country are operating over a grooved rail that requires a very thin, shallow flange? Not 1 per cent. Another wants a deep flange for conditions approximating steam road practice. Is there any evidence more than a theory that such deep flanges are a necessity? If there is, it should be unearthed. Another objection is that some want a broad tread, and others a narrow one. Practice favors a tread the same width as the rail-head. If this practice is wrong, it should not be used in the standard wheel, and nobody should desire to use it. If it is right, why should there be any deviation from it? In other words, the standard wheel, if adopted, should be a combination of the best teach-

ings of experience. Conditions are not so widely different but that one or possibly two standards can be adopted which will suit all cases. There is absolutely no reason for the greater part of the variations in practice which exist at present. Why should half a dozen roads operating under exactly the same conditions require half a dozen different forms of wheel-flanges and -treads?"

It appears that a consensus of opinion upon the wheel question has never been sought previous to this effort to obtain it. "Every man has his own theory as to what is the proper wheel. Accordingly, there are hundreds of patterns, only a few of which can be of the correct form. One well-known superintendent expressed the opinion recently that a bevel was absolutely necessary to success in street-railway operation, and that, in fact, so dependent is success on the little things, that street-railroading would have been a failure had it not been for the bevel on the wheels. That was stating it rather strongly, especially in view of the fact that some men do not believe in any bevel whatever, and are operating successfully with wheels having a flat tread. It is hard to determine what originally led to the bevel of wheels on steam roads, but very likely it was the greater ease with which they could be drawn from the chills in which they are cast. The efficacy of the bevel is by no means established. On the anti-bevel side may be mentioned some of the large systems of St. Louis and the Denver Tramway company. The opposite extreme is represented by the Chicago City Railway, which has a very large bevel on its wheels, and is laying beveled rails to correspond. So it will be seen that, on one of the first and most important points to come up when the question of a standard wheel-tread is broached, there is a difference between the best of authorities. Which is right? A standard ought to be adopted, if for no other reason than to cause an investigation as to what is actually the best wheel-tread and -flange. The rail-heads used by street railways, whether on T-, girder-, or grooved rails, are now nearly all of the same shape as regards the part on which the wheels and flanges have contact. Girder-rails are flat headed, and modern T-rails are the same. There is, therefore, not the difficulty of a variety of rail-heads to stand in the way of this reform." Some of the letters on the subject from railroad men indicate that the subject will be of general interest, and that the discussion is well-timed.

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**Street Railway Motormen and Car Repairs.**

IN an article on this subject by Harry F. Reynolds, in *Street Railway Review* (March), the extent to which an incompetent or careless motorman runs up costs for repairs for the company employing him, and the way in which a good motorman keeps down costs of repairs, is well set forth. In the case of two cars, the one run by a thoroughly competent man, the other by one of the opposite character, the repairs on the car run by the former was $30, while repairs on the car run by the latter was $420. Both these motormen were experienced. One was intelligent, conscientious, and careful; the other reckless, and indifferent to the interests of his employers. Speaking of the car run by this man, the author says:

"In less than one month this car was run off a 20-foot embankment, precipitating car, passengers, and motorman to the bottom, falling on one end, with the passengers, seats, mats, and trap doors, intermingled with broken windows, all in one promiscuous mass. The passengers were extricated from their perilous position with only one injured, and by the use of a small amount of cash and a large amount of diplomacy a damage suit was prevented. The end of the car was smashed, besides all the windows broken. The cost of raising car and repairing was $100. This accident was caused by excessive speed at a dangerous portion of the track. Shortly after this a new man was put in charge of the car; a bolt became broken, and fell in the motor; before it was discovered, the armature was ruined, which cost $160. After retaining this man for more than a year, the cost of repairs became too high, and a new man was substituted. He became

ambitious in the start, and in a few weeks disputed the right of way with a switch engine at a railroad crossing and came off *hors du combat*. His car was thrown from the track, with one side demolished and an axle broken; repairs, $100. In less than two weeks after the car was put on again, one morning, when going to the station, the motorman informed me that one of his motors was sparking badly. I looked at it, and found that a bolt had become detached and had torn off the commutator connections of over half of the coils, which were damaged beyond repair; cost of rewinding, $60. The amounts for these repairs are $420, which could, with careful management of the car, have been avoided. Each of these cars had the same mileage, 122 miles per day, over the same track. The loss incurred by this car being in the barn has not been calculated."

Mr. Reynolds does not credit the statement of a Brooklyn street railway manager who asserts that he can make a good motorman out of any man of ordinary intelligence in one week, but believes that the accident and repair account of this road would tell quite a different story. "The man who has charge of the car on which only $30 were expended has become an ideal motorman. He understands his car, and, when he has any time at the end of his run, inspects the motors. If any trifling derangement of the car takes place, he repairs it temporarily, and reports the same at night to the barn foreman. He understands how to start and stop a car, which, I am compelled to say, very few motormen do understand. I desire to say right here, motormen are like poets, 'born, not made,' and no amount of coaching or instruction can make a man understand how to handle a car unless he possesses the natural knack. Some men learn readily, and others not at all; with some men it is not all incapacity, but indifference, thinking they have learned it all, which is as bad or worse. I would rather have a man who tried conscientiously to do his duty and failed, than one who did not care, and failed through indifference, or even over-confidence in his ability."

Mr. Reynolds speaks from the book, his remarks being based on his own experience in the management of a street railway. A short conversation with almost any of the Brooklyn motormen by one who knows a little of the details of electric car propulsion will convince the interviewer that, if ignorance is a factor in cost of repairs, the electric lines of that city must find this item a large one in the total annual expense account.

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### Train-Robbing.

THAT this variety of crime is on the increase is shown by the following statistics taken from a letter to *The Railway Age* (March 15) by G. W. Agee. In 1890, 12 trains were held up; in 1891, 16; in 1892, 16; in 1893, 33; in 1894, 34,—111 in the 4 years named. In these "hold-ups" twenty-seven lives were lost, and thirty people were injured. Mr. Agee supposes that the people "who are cudgelling their brains at the present day with the hope of evolving some solution of this so-called much-vexed problem would outnumber the standing army of the United States."

Many of the remedies proposed are mentioned only to show their futility, and then the author enrolls himself in the army of remedy-proposers. He proposes that train-robbing should be dealt with in the same manner as the crime of highway robbery of United States mails, for which the penalty is imprisonment for life. The newspapers are also held to be in fault. "In fact, train-robbing is the best-advertised business in America at the present day. The daily press is, unwittingly, a most potent factor in the promotion of this class of crimes. According to modern journalism the routine happenings of life are not news. Hence the tendency to sensationalism and to exaggeration which is so universally indulged by the press. Fabulous sums are heralded in flaming headlines as the booty secured, and the ignorant and unthinking masses, from whose ranks criminals come, are led to believe that large rewards attend the successful accomplishment of this crime." A number of examples of gross exaggeration of amounts looted from trains which have been printed in the daily press are cited to prove this, and it is asserted that

"express companies spend annually ten times more than they lose by these thefts in the pursuit and prosecution of this class of criminals, but, handicapped as they are by inadequate laws, the results do not tend to the suppression of the industry."

In conclusion it is maintained that, while "there is no positive antidote" for train-robbing, its "regulation and suspension demand that express companies should divest the business of train-robbery of all profit by the use of burglar-proof safes; that congress should give, by federal statute, the same protection to all Inter-State commerce as it gives to the United States mails; and that the daily press of the country should not advertise the business of train-robbery, as a paying industry, when the facts, easily accessible, will show that it is not."

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ONE of the events looked forward to with interest in railroad circles is the International Railway Congress to be held in London at the Imperial Institute, Kensington, June 26. The American Railway Association, which has now become a member of the International Railway Congress, will be represented by an able delegation of eight representative railway men, two of whom, Mr. H. S. Haines, president of the Association and vice-president of the Plant System, and Mr. W. F. Allen, secretary of the Association and manager of the *Official Railway Guide*, have been named at the present writing. The following railway companies are members of the Congress, and entitled to send delegates on their own account: to wit, "Louisville and Nashville; Pennsylvania; Denver and Rio Grande; New York, New Haven and Hartford; Chesapeake and Ohio; Fitchburg; Richmond, Fredericksburg and Potomac; Arizona and South-eastern; Los Angeles Terminal. The session will be held in the Imperial Institute in Kensington. The last session of the Congress was held at St. Petersburg, Russia, in 1892, and the one before that at Milan, Italy."

Conventions of this kind are significant of the fact that industrial progress is rapidly effacing national boundaries. In engineering, "the field is the world." Aspirants for prominence in the profession are not limited by national prejudices as formerly.

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Railway Affairs in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

*29992. A New Great Northern Engine. Charles Rous-Marten (Eng L-March 1.) 1800 w.

*29994. Automatic Railway Signalling. Editorial (Eng L-March 1.) 2000 w.

*30001. Steam Tramways in Italy. Ill. P. Amoretti (I & I-March 1.) 3800 w.

*30034. The Light Railway Question.—Interview with Mr. Meik (Tr-March 1.) 2600 w.

30044. Altoona Shops of the Pennsylvania Railroad.—The Freight Car Shop, B. F. Evans (R C J-March.) 3500 w.

30057. The McGann Arbitration Bill. Joseph Nimmo, Jr. (R R-March 9.) 900 w.

30058. Government Ownership of Railway Mail Cars.—From Railway Equipment Guide (R R-March 9.) 1100 w.

30063. Street Car Compressed Air Motor.—Trial of the Hardie Air Motor. From Rome (N. Y.) Sentinel (S C A-March 16.) 700 w.

30067. The Industrial Use of Motors on Power Circuits, Operated by the Street Railway Company at Los Angeles, Cal. Ill. George Heli Guy (E E N Y-March 13.) 3000 w.

30097. Baltimore and Ohio—The Pioneer Railroad—Interesting Sketch of Its Origin and Progress. Ill. (I Age-March.) 1800 w.

30100. Smith's Three-Cylinder Locomotive. Ill. (R G-March 15.) 700 w.

30101. Track Elevation in Chicago (R G-March 15.) 2400 w.

30102. Railroad Discipline. F. G. Darlington (R G-March 15.) 2300 w.

30105. The Design of Locomotives for Fast Passenger Service. Hugh Sharp (E N-March 14.) 1000 w.

30107. Methods of Clearing Away Railway Wrecks. (Extract.) W. L. Derr (E N-March 14.) 1700 w.

30140. The Railways of West Virginia. Anon. (M R-March 15.) 5000 w.

*30148. Street Railway Motormen and Car Repairs. Harry F. Reynolds (S R R-March.) 1600 w.

*30149. A Perfect Rail Bond. Harold P. Brown (S R R-March.) 1800 w.

*30150. New Cable Line of Columbia Railway Company, Washington, D. C. Ill. (S R R-March.) 2500 w.

*30152. Safety Gates at Minneapolis. Ill. (S R R-March.) 700 w.

*We publish copies of these articles. See Introductory*

30153. Train Robberies. G. W. Agee (R A-March 15.) 1500 w.

30154. Protection of Tracks Against Snow. Ill. Extract from Address of James Manning (R A-March 15.) 1500 w.

*30155. Narrow Gauge Railways in the Canton of Geneva. Ill. (R W-March.) 2000 w.

*30156. Six Wheels-Coupled Mineral Engine, North Eastern Railway. Ill. (R W-March.) 200 w.

*30157. Bristol Tramway Cars. Ill. (R W-March.) 1600 w.

*30159. Some Links in Locomotive History. Ill. Clement E. Stretton (R W-March.) 350 w.

*30182. Light Railways. Editorial (E-March 8.) 3800 w.

*30189. Parliamentary Procedure re Light Railways. W. Worby Beaumont and Stephen Selion (I & I-March 8.) 5000 w.

*30230. Ties and Poles for Railway Work. J. H. Godfrey (S J E-March.) 1200 w.

30243. Railway Legislation. Editorial (R R-March 16.) 1200 w.

30244. The Railway Signaling Club. Editorial (R R-March 16.) 1000 w.

30280. The New Railroad Station in Cologne. Ill. (Sc A S-March 23.) 1100 w.

*30294. The United Verde and Pacific Railway. Ill. Elbridge H. Beckler (J A E S-Feb.) 7500 w.

30296. Rapid Transit in Large Cities. March Meeting of the A. S. M. E. Paper by W. B. Parsons, with Discussion (R G-March 22.) 3500 w.

30297. The New St. Albans Freight Yard—Central Vermont Railway. Ill. (R G-March 22.) 150 w.

30298. The Cost of Heating Cars by Electricity. Editorial (R G-March 22.) 900 w.

30299. The Progress of Railroad Reorganization. Editorial (R G-March 22.) 1200 w.

30313. The New Electric Underground Railway in Budapest. Ill. (E N-March 21.) 2200 w.

30316. The New Conduit Electric Railways. Ill. (E N-March 21.) 800 w.

30317. Recent Progress in Railway Car Lighting (E N-March 21.) 1300 w.

30318. Underground or Elevated Construction for the New York Rapid Transit Railway. Editorial (E N-March 21.) 3000 w.

30319. Specifications for Buffalo Grade Crossing Work; N. Y. C. & H. R. R. R. (E N-March 21.) 2500 w.

*30365. Railroading in America. Ill. By an English Railway Engineer (Eng L-March 15.) 2200 w.

*30366. The Jubilee of Express Trains. Anon. (Eng L-March 15.) 1800 w.

*30380. Light Railways. Editorial (P Eng-March 15.) 1100 w.

*30415. The Indian Railways (Tr-March 15.) 700 w.

30430. A Sermon on Transportation. George H. Daniels (R R-March 23.) 2700 w.

30431. The New Rules of Interchange. Editorial (R R-March 23.) 1200 w.

30432. Slope of Cuts. Jerry Sullivan (R R-March 23.) 600 w.

30496. A Suggestion for New York Rapid Transit. Ill. Fr. von Emperger (R G-March 29.) 1000 w.

30498. Automatic Air-Brakes Without Angle Cocks (R G-March 29.) 900 w.

30499. The Santa Fé, Prescott and Phoenix Railway. M. J. Lorraine (R G-March 29.) 1500 w.

30501. Competition of Electric Street Railroads. Editorial (R G-March 29.) 1400 w.

30502. Power and Efficiency of Locomotive Boilers. Editorial (R G-March 29.) 2600 w.

†30527. The Successor of the Railway. Appleton Morgan (P S M-April.) 5000 w.

30528. Electric Railway Power Plant in Allentown, Pa. Ill. (S R G-March 30.) 1200 w.

30529. Rights of Pennsylvania Suburban Electric Railways—Abstract of the Opinion of Judge Williams (S R G-March 30.) 1200 w.

30530. In Behalf of Connecticut Electric Railways. Abstract of Judge E. B. Gager's Address (S R G-March 30.) 1800 w.

30542. Adjuncts of a Modern Railroad Station. Ill. Fred. H. Colvin (M A-April.) 800 w.

*30560. Timber Cross Sleepers as Track Gages. Ill. Joseph Anthony (L E-April.) 1200 w.

*30561. Breakage of Axles. Editorial (L E-April.) 1600 w.

*30562. Automatic Air Brakes Without Triple Valves. Ill. Paul Synnestvedt (L E-April.) 1000 w.

*30563. Are Leakage Grooves of Any Use?—Drainage of the Drum and Pipes. Will W. Wood (L E-April.) 2000 w.

*30564. Why Does a Locomotive Boiler Explode When It Has Sufficient Water and Working Under Ordinary Steam Pressure? James Hughes (L E-April.) 1000 w.

*30566. Body Bolsters. Ill. Orville H. Reynolds (L E-April.) 2500 w.

*30596. Tramways on Mountain Roads. Editorial (Eng L-March 22.) 1100 w.

*30597. Electrical Tramway with Underground Conductor.—Lyons Exhibition. Ill. (Eng L-March 22.) 2400 w.

*30601. The Narrow Gauge Delusion. Editorial (A E R J-April.) 3000 w.

*30605. Economic Use of Coal in Locomotive Service. Ecitorial (N C B-April.) 3500 w.

*30609. Mechanical Power on Our Tramways. Philip Dawson (E R L-March 22.) 1200 w.

30611. The Advantages and Disadvantages of a Lock and Block System on a Busy Line of Railway. (Abstract.) H. Raynar Wilson (R R-March 30.) 1300 w.

30613. Locomotives of the Egyptian Rail-

ways. Ill. Clement F. Street (R R–March 30.) 500 w.

30614. Railroad Discipline. F. G. Darlington, with Editorial (R R–March 30.) 2500 w.

30615. The Handling of Private Cars. Editorial (R R–March 30.) 900 w.

30616. Railroads and Business Panics.—From the 26th Annual Report of the Massachusetts Railroad Commission (R R–March 30.) 1200 w.

*30622. Portable Railways for Works and Factories. (Abstract.) Ill. J. Walwyn White (E–March 22.) 4500 w.

30637. Railway Ships vs. Ship Railways. Editorial (R A–March 29.) 1100 w.

30638. Can Snow Blockades Be Avoided? J. W. Russell (R A–March 29.) 3000 w.

†30653. The Street Railway System of Boston. Ill. (S R J–April.) 18000 w.

†30656. The Quality of Street Railway Cables. Ill. R. J. McCarthy (S R J–April.) 2500 w.

30707. Portable Wood-Preserving Plant; Southern Pacific Railway. Ill. (E N–April 4.) 1600 w.

30708. Automatic Block System and Electro-Mechanical Slot; P. & R. R. R. Ill. (E N–April 4.) 1700 w.

30758. The New Shops of the Louisville, New Albany and Chicago Railway, at La Fayette. Ill. (R E M–April.) 1400 w.

30761. The St. Louis Union Passenger Station. Ill. (R G–April 5.) 1000 w.

30764. Oil for Locomotive Fuel in Southern California. Ill. George B. Leighton (R G–April 5.) 1500 w.

30765. Interlocking for an Electric Crossing.—Catlettsburg, Ky. Ill. (R G–April 5.) 600 w.

30766. The Right of the Electric Railroad in the Highway. Editorial (R G–April 5.) 2000 w.

*30773. Rolling Stock for 30 in. Gauge Railway in India. Ill. (E–March 29.) 1200 w.

*30774. French Railways and the State. Editorial (E–March 29.) 3800 w.

*30780. A Novel Idea for a Railway Surfaceman's Alarm. Ill. Charles R. Gibson (E L–March 29.) 1200 w.

*30790. On the Employment of the Electric Light for Railway Purposes. Ill. W. Langdon (E E L–March 29.) 9000 w.

30794. The Legal Aspects of Electrolysis. Henry C. Townsend, in Cassier's Magazine (S R G–April 6.) 5000 w.

30816. Duties and Responsibilities of a Railroad Bridge and Building Department (R R–April 6.) 3200 w.

30817. Feed Water, Circulating, and Blow-off Arrangements for Locomotives. Ill. (R R–April 6.) 1000 w.

30818. Protection of Grade Crossings of Steam and Electric Railways. Ill. (R R–April 6.) 1400 w.

30819. Terminals. W. A. Garrett (R R–April 6.) 3500 w.

30820. Competition of Electric Railways. Editorial (R A–April 5.) 1100 w.

30821. Passenger Train Service Between Washington and New York (R A–April 5.) 1800 w.

30822. Protection of Grade Crossings of Steam Railroads with Electric Railways. Ill. Charles Hansel (R A–April 5.) 1800 w.

30825. Pullman Car Trucks. Ill. Duane Doty. (R C J–April.) 1000 w.

†30827. The Railway to India. C. E. D. Black (C R–April.) 4000 w.

Serials.

17826. Evolution of the Air Brake. Ill. Paul Synnestvedt (R E M–Began Dec., 1893—14 parts to date—15 cts. each).

18435. Painting a Railway Passenger Car. A. Ashmun Kelly (R E M–Began Jan., 1894—12 parts to date—15 cts. each).

27603. A Treatise on the Construction of Railroad Rolling Stock. Ill. A. Flamanche, A. Huberti and A. Stevart (R C J–Began Jan.—4 parts to date—15 cts. each).

28138. Block Signaling. Ill. W. H. Elliott (L E–Began Jan.—4 parts to date—30 cts. each).

28304. Signals and Signaling. Ill. (R R–Began Jan. 5—8 parts to date—15 cts. each).

28496. Electric Traction. Ill. Philip Dawson (E–Began Jan. 4—12 parts to date—30 cts. each).

28897. Motor Repairs. Ill. (S R J–Began Feb.—3 parts to date—45 cts. each).

29144. Economy in Railway Operation. L. F. Loree (E Mag–Began April—2 parts to date—30 cts. each.)

29175. On Electric Cable Railways. Ill. C. S. Du Riche Preller (E–Began Feb. 1—4 parts to date—30 cts. each).

29369. Tramway Management. By a Manager (R W–Began Feb.—2 parts to date—30 cts. each).

29384. Street Railway Wheel Treads and Flanges.—Is a Standard Desirable? Ill. (S R R–Began Feb.—2 parts to date—30 cts. each).

29775. Yard Arrangements Along Heavy Traffic High-Speed Railroads. Ill. A. Flamanche (A E R J–Began March—2 parts to date—30 cts. each).

29881. Light Railways. J. Walwyn (I Eng–Began Feb. 2—2 parts to date—45 cts. each).

30158. Notes on Some French and Swiss Railways. Ill. (R W–Began March—1 part to date—30 cts).

30604. Locomotive Repair Shop Equipment. W. H. Weston (N C B–Began April—1 part to date—30 cts).

30654. Electric Railway Repair Shops. Ill. Henry P. Merriam (S R J–Began April—1 part to date—45 cts).

†30668. The People's Highways. Frank Parsons (A–Began April—1 part to date—45 cts).

30787. Light Railways in Belgium. Anon. (Eng L–Began March 29.—1 part to date—30 cts).

# SCIENTIFIC MISCELLANY

### Scientific Illiteracy.

THE *Home Journal* (April 3) editorially criticises the too frequent illiteracy of contributors to the technical press. This charge has been made previously by other critics, and it may be well to consider it carefully. If it be true of those who have been trained in the leading technical schools, it certainly is not creditable to these institutions.

"Any one," says our contemporary, "having frequent occasion to examine the pages of the technical periodicals published in the United States cannot fail to be impressed with the fact that they are frequently written in English that should disgrace any graduate of an ordinary grammar school. It is difficult to account for this fact. Of course it is natural enough that among inventors and experimenters in applied science there should be a considerable proportion of men entirely without literary training. But, on the other hand, the technical schools and colleges supply the country yearly with hundreds and even thousands of young engineers who are supposed to have passed through a curriculum combining with science at least so much study of letters as is necessary to fit one for ordinary English composition. That from this vast body the scientific press should not be able to recruit staffs capable of maintaining its literary standard at a level with that of the average country daily newspaper is indeed phenomenal.

"The lack here deplored is not that of fine writing, or marked individuality of style, or studied rhetoric; these would be out of place in technical literature, which should be characterized by simplicity itself. Of technical writers there is no reason to demand greater literary power than that of constructing a grammatical, coherent, and intelligible sentence. But even this modest expectation is too often disappointed. The present writer has seen, not one, but many manuscripts written by professors occupying chairs in the scientific departments of colleges like Columbia, the meaning of parts of which it was almost impossible to ascertain, even when the subject was not difficult or the language technical. And yet nowhere is lucidity more to be desired than in scientific writing.

"To be sure, there are technical periodicals to which our complaint does not apply, but these are notable exceptions. One of these is the ENGINEERING MAGAZINE, whose original matter appears in clear and correct English. To its pages, however, one may turn for compact and accessible proof of the charge preferred. For it publishes each month an extensive review of the techinal press, much of which consists of quoted passages selected from technical periodicals for their scientific interest and value. So far as this review is rewritten, its English is correct and intelligible, but the quoted parts sometimes offer an extraordinary variety of involved and ill-constructed sentences. No blame for this attaches to the review itself, for it would be an enormous task to rewrite the whole, and an impropriety to take serious liberties with the matter enclosed in quotation marks. But the result is an astonishing revelation, especially as it is supposed to represent the better portion of the technical press. We wish that some of our technical contemporaries would endeavor to throw light upon the question why men of technical training should so often prove bunglers with the pen."

Now, the fact is that many of those who contribute to technical literature are men more or less advanced in life, who were in active service before the era of technical schools began.

Their education has not been systematic. A varied and wide experience has been the principal school of whose advantages they could avail themselves. Many of them are conspicuous for genius and ability. They have learned much, have much that is extremely valuable to communicate, and it has been well for the

world that their consciousness of some lack of literary training has not kept them out of print.

Their lack of literary skill would be far less conspicuous, were their manuscripts more carefully edited. Want of care in revising "copy" is apparent in many of the very best of our technical publications. But, after all, it is not so much the manner of presentation as the matter that renders valuable the writings of this class of men. Contrary to the opinion of our contemporary, we think it would be desirable (were it possible) in all cases to couple with sound technical doctrine the graces of style; but an over-seasoning of the latter in technical writing, like a trick practised in cookery, has too often cloaked the lack of nourishing meat. It is, nevertheless, desirable that grammatical usage should be followed, and it is essential that sentences should be so constructed that their meaning shall be neither obscure nor ambiguous. If to these requisites the graces of rhetoric supply an added charm, —as, for a conspicuous example, in the scientific writings of the late Professor Tyndall, — they render the composition more acceptable to all cultivated readers; but this cannot be expected from the majority of technical writers.

But what shall be said of the lapses in style, grammatical form, and involved construction of sentences found in much of the literary work of college graduates and graduates of technical schools? This has not the excuse which may be offered for the work of graduates from the school of experience, and whose opportunities for acquiring skill in writing have been very meager. Is it not true that, as a rule, ample instruction and practice in English composition are not given either in colleges or technical schools? We believe the answer must be that this defect in our system of education is general. Of course there are exceptions.

A good style in English technical composition consists in the use of pure English and clear expression of ideas. It does not, however, necessarily imply that the charm of elegant rhetoric is to be deprecated in such writing, or that pleasing imagery cannot be used in illustrating a point. If the works of Tyndall were robbed of the beautiful style of that eminent writer, they might still retain their scientific value, but they would lose much for which they have commanded just admiration. But it is much better not to attempt such flights unless the imagination has learned to use its wings judiciously. In the palmy days of Union College, when Dr. Nott was president of that institution, it turned out some good public speakers and graceful writers. It is related that Dr. Nott, after having read a curiously involved sentence of thirty or forty words in a composition by one of the students, describing a peculiar effect of a blow upon the head,—the paragraph referring to what the patient did after receiving the blow,—was able to interpret the meaning to be that "he [the patient] went up-stairs and lay down."

"Is that not what you mean to have the reader understand, Mr. Blank?" asked Dr. Nott.

"Yes," replied Blank.

"Then why not say that, Mr. Blank?" and crossing out the clumsy effort at high style, the genial instructor penciled the seven words on the margin of the paper.

If many aspirants for literary fame would ask themselves first, "What is it I mean to say?" and, after having determined this point, would repeat Dr. Nott's query, "Then why not say that?" they would by such self-discipline acquire the art of writing simple, pure, strong English; and, as a help to fame and fortune, in an English-speaking land, this art is second to no other accomplishment that a professional engineer can possess. The ability to prepare a paper not only rich in valuable facts, but written in a happy, easy style, at once attracts the attention of his compeers, and brings him into prominence. In presenting to the public any scheme of improvement, or any engineering work with which he wishes to be identified, this talent enables him to impress its merits upon the minds of those he desires to enlist in the enterprise with a force that gives him immense advantage over a

clumsy, slovenly writer. And all along the line of his work, in preparing specifications and reports, as well as in general correspondence, a good literary style will greatly enhance the effectiveness of what he desires to convey, thus strengthening his reputation and influence.

But, while admitting that the criticism of the *Home Journal* writer is justly applicable to the majority of technical writers, and that this fault indicates a defect in the schools from which they graduate, there are many notable exceptions whose writings are always clothed in a graceful, agreeable style. Naming off-hand a few of these, we shall necessarily omit many equally good.

Among civil engineers W. H. Caniff, Charles B. Going, and Benjamin Reece are at once recalled. Among sanitary engineers the names of Col. George E. Waring, Charles F. Wingate, and W. Paul Gerhart occur to us. Of mechanical engineers the first names of good writers remembered are Coleman Sellers, A. E, Outerbridge, Jr., and Dr. Charles E. Emery. Upon subjects relating to mining and metallurgy Professor R. W. Raymond and William L. Austin may be classed among the best writers in the country. Among the best writers on Architectures may be named Mr. E. C. Gardner and Mr. John Beverley Robinson. Among the numerous writers upon electrical subjects we readily recall the names of Elihu Thompson, Thomas D. Lockwood, Herbert Laws Webb and Albert A. Hopkins. Acceptable writers in the faculties of the technical schools include Professors R. H. Thurston and C. W. MacCord. Col. H. G. Prout, editor of *The Railroad Gazette*, Thomas Commerford Martin, editor of the *Electrical Engineer*, and Fred. Miller, editor of *American Machinist*, might well be three names with which to head a list of editorial writers upon technical subjects. If we made an effort to complete a list of good writers in all lines of engineering industry, we should require much more space than is at our command. A much larger list could be made of those whose "copy" would merit the criticism our contemporary has inclusively bestowed upon technical writing. We hope its attempt to call public attention to the illiteracy of technical writers may result in improvement; but, until greater attention to English composition is given in the technical and high schools, such improvement cannot be confidently expected.

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### Fire-Brick Clays.

THE refractory clays, commonly known as "fire-brick clays," of which large deposits are found near Perth Amboy, New Jersey, are made the subject of an instructive article by Mr. Charles Terry in *The Iron Age* (Feb. 4). In the first place the geological character of these deposits —"pure sedimentary clays"—is noted, and then their chemical composition is treated, these clays being refractory on account of their freedom from "accidental fluxing impurities,—namely, lime, magnesia, iron, and the alkalies,"—of which they do not contain in the aggregate more than 1 per cent.

"The beds afford every variety of pure clay, from those highest in alumina to the most siliceous clays, including the extra sandy, fire sand, and pure white quartz sand. Such an assortment of refractory resources is plainly an ideal basis to work from in making fire-brick mixtures, but a proper classification and application of them can only be reached by scientific means. With such a source of supply the fire-brick manufacturer derives great benefit from studying the conditions which exist in places where his fire-brick are to be used. It is impossible to make one grade of brick which will meet the requirements of the various classes of work equally well. The chemical composition and physical structure of fire-brick should differ as radically as the nature of the conditions which they must encounter. There are reasons why a high silica brick should give better results in certain places than one high in alumina; while, conversely, there are times when a high alumina fire brick is more desirable than a pure silica fire-brick. Lime, magnesia, and the alkalies, forming fusible silicates with the silica of fire-clay, are usually eliminated to the greatest possible extent, though, in places

where the heat is moderate in intensity and the brick are obliged to endure a great deal of severe abrasion, a small percentage of these accidental impurities works to advantage, in so far as it tends to toughen and harden the fire-brick when burned. It is a very simple and comparatively inexpensive matter to add a limited quantity of such substances to the mixtures in the process of manufacture; but to extract them from an impure clay is not only very difficult, but thoroughly impracticable. As a rule, the New Jersey fire-clays carry exceedingly small percentages of these impurities, if any, and are in perfect condition, chemically, for use. The deposits of New Jersey consist entirely of sedimentary, plastic fire-clays in a thoroughly disintegrated state. From an economical standpoint their conditions in this respect could not be improved."

The eye alone can not determine the quality of fire-brick. To the inexperienced eye, at least, they all look very much alike. Only a chemical analysis can determine their value in advance of their actual use. Fire-brick for different purposes must have different composition, "and the manufacturer must know how to adapt these various kinds of refractory material so as to insure the best scientific and practical result. If you should go to an iron manufacturer who is engaged in the production of pig, puddled, merchant, or cast iron, and ask him to tell in a general way the important characteristics of a superior fire-brick, his answer would probably be substantially as follows: 'One which burns (or fuses) very slowly, evenly, and without any tendency to waste away as a result of chipping off when subject to sudden changes of temperature.'"

As an illustration of the effect of mixtures, the mixture may be modified so as to reduce its fusibility, "though, if this is carried beyond a certain point, the ability of the brick to expand and contract suddenly is seriously impaired. Such a procedure is worse than robbing Peter to pay Paul, for in this case Peter's loss much exceeds Paul's gain." In conclusion, it is asserted that, if "a New Jersey fire-brick maker does not vindicate a supremacy in his pursuit by showing an ability to supply a highly superior fire-brick for any purpose, it is only because he has not properly formulated his brick mixtures."

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**The Bicycle in Health and in Disease.**

THE use of the bicycle has become so common with both sexes that the opinion of an eminent medical authority—Græme M. Hammond, M. D., of New York, professor of diseases of the mind and nervous system in New York Post Graduate Medical School—upon its use as related to health will interest many readers. His exhaustive paper on this question, recently read before the New York Academy of Medicine, will doubtless be widely quoted in future discussions upon the advisability of bicycle exercise for persons in degrees of health varying from debility to full vigor.

The facts given in the paper are derived from physiological examination of subjects who have used the bicycle to a greater or less extent. Dr. Hammond asserts that he has found bicycle exercise a valuable therapeutic agent in the treatment of certain nervous diseases. As to its proper and reasonable use, he finds, from actual examination of subjects by methods and instruments which modern science has supplied, that healthy growth of the heart and increase of cardiac power results from bicycle exercise, and that the "breathing capacity of bicycle riders is largely in excess of that of the average man." These are conditions favorable to the continuance of robust health. "The muscular system of the bicycle rider is, as a rule, uniformly well developed. It is often claimed by those who are not properly informed that the exercise develops the muscles of the legs at the expense of the rest of the body. This is not so. On the contrary, the muscles of the back, chest, arms, and abdomen are employed a great deal – not to the same extent as the muscles of the legs, but sufficiently so to consider bicycle riding an exercise inducing general development of the muscular system. A great deal has been said in regard to the pernicious effects of riding with the body almost, if not quite, at a

right angle with the legs. A peculiar malformation of the spine has been reported to result from this posture, and it certainly seems as if the lungs, and consequently the heart, must be greatly hampered in performing their work. To obtain some information on this subject I have carefully examined fourteen professional riders, seven of whom are the most celebrated racing-men in the world,—men who have obtained national reputations as great riders, who have ridden more races than any other men, and who always ride with the body at right angles to the legs. In no case was there any deformity of the spinal column, and I may say here, if any such condition has ever been observed, the number of cases of it must be very few indeed. I have never seen a case of it." The riders examined "were all well-built and muscular men, but . . . there was excessive development of the muscles of the thighs."

Excessive work on the wheel is pronounced to be "unquestionably injurious. Riding great distances at rapid speed is an abuse of the wheel which cannot be too severely condemned. . . . Moderate exercise, properly performed, invigorates the system, strengthens the muscles, and increases the powers of physical endurance, but excessive and exhaustive exercise does none of these things; on the contrary, it is decidedly injurious to health, and should never be encouraged. The position of the saddle should in all cases be such that the weight of the body is supported on the gluteal muscles, and not on the perineum; otherwise diseases of pelvic organs may result both with males and females."

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### Textile Schools in Massachusetts.

A MOVEMENT for the establishment of schools for imparting expert instruction in the manufacture of textiles is on foot in Massachusetts, and bills introduced in the legislature providing for the founding of such schools are now under consideration by the legislative committee on education. *The Boston Journal of Commerce* (March 16) gives an account of a hearing of arguments in favor of such schools by this committee. Many prominent citizens and some public men addressed the committee on this occasion. The diminution of skill and knowledge among New England millers was generally admitted by these speakers, and by some was lamented as the cause of the loss of prestige in textile manufacturing industries which has marked the history of this section since 1865.

On the Wednesday following this hearing, another audience was given to a number of Lowell citizens, who, in the main, expressed similar views. Ex-Senator Lawton said that it is the intention to make this school distinctly American. "The question is not," said Mr. Lawton, "one of education, but rather one intended to advance the labor interests of our State and industries. It is the purpose to give all who have started on a business career in this particular line an opportunity to extend their knowledge. It is the desire of the gentlemen to have a school which, for the present, will be open only evenings, and will be attended by those now employed in the mills. Lowell is particularly well adapted for such a school, being, generally speaking, the largest and oldest textile city in the State."

"James T. Smith, secretary of the Lowell Board of Trade, said that the idea of establishing a textile school originated with the citizens of Lowell, who had come to the conclusion that it might solve the problem of competition. A. G. Cumnock, agent of the Boot cotton mills, said that he appeared before the committee as a manufacturer, feeling the necessity of such a school. It is assured, said Mr. Cumnock, that a full set of machinery can be secured without cost, and all that is needed now is a cheap building, some power, and a good instructor. As to the advantages of Lowell, Mr. Cumnock said that there the largest carpet-mill in the world is operated; also one of the largest woolen-mills in the country. It also has the largest machine-shop in the commonwealth, and one of the largest knitting establishments in the country. He advocated opening the textile project with an evening school which shall not be a class one. He didn't want it to be understood that it was to be

a rich man's school. Begin at the bottom. He then exhibited, to the interest of all, some samples of the industries of Lowell, and proceeded in an enthusiastic way until Chairman Roe said: 'That means good-bye to the Lowell School of Design' (connected with the Boston technological school)."

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### The Saxony Tanning School.

THE only school of its kind in the world, a school of tanning, is stated by the *Scientific American Supplement* to have been established in Freiberg, Saxony. From a report of the United States consul at Chemnitz, the following facts relating to this unique school are gathered. "The school was opened in 1889, and its object is stated in its name. In it instruction is given in practical and theoretical preparation of leather in tanning and in finishing. It is supported by the State, which devoted to it the sum of 5000 marks in 1893; by the city of Freiberg, which contributed 1500 marks; and by friends, who gave it 2385 marks. Besides money, presents of hides, rare pieces of leather, barks, nuts, etc., are sent to it, and also magazines and technical papers. Its scholars come from all parts of the world. Every year—since 1889—students from Prussia, Austria, Roumania, France, Meiningen, Russia, Holland, Switzerland, Bavaria, Oldenburg, and Saxony have been in attendance. For practical work the school is fitted up from cellar to garret with all kinds of machinery, from the steam engine, furnishing power, to the finishing machine that turns out the finest patent or calf leather. There are rooms and machines for the unworked skins, lime-baths, vats, and cutting, rolling, pebbling, stretching, and pressing machines. It is stated that all the machinery used was made in the United States, and the director of the institution worked for ten years in the tanneries of that country. The students devote most of their time to studying tanning, preparing, and finishing leather. They learn about oxygen, alkalies, carbo-hydrates, albuminoids, and fermentation. They study text-books and hear lectures. In addition they work in the tannery and the laboratory."

Dr. Schnoeder is the head of the corps of chemists and teachers. "Under these again is a regular corps of practical tanners, who take a hide, as it leaves the animal, through lime-baths to the polishing rolls and processes, watched at every stage by the students. To this work the students give at least ten hours a week,—two hours daily. Hides from all parts of the world are experimented on annually, and with all kinds of tanning, barks, and materials." The old processes are compared with the new. "The former give good, and the latter quick results; the former are expensive, the latter cheap." All the various materials in use for tanning are made the subject of both practical and scientific study. The different processes and their theory and practical effects are all studied in a thorough manner.

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THE Chemical Society has conferred its Faraday medal upon Lord Rayleigh in recognition of the investigation which led to the discovery of Argon. Dumas, Canizzaro, Wurtz, Helmholtz, and Mendeléeff were the previous recipients.—*Science.*

## THE TECHNICAL INDEX—1895.

*Current Leading Articles on Various Scientific and Industrial Subjects in the American and English Technical Journals—Abbreviations are clearly explained in the Introductory.*

*29955. Meaning of the Recent United States Patent Decision. Park Benjamin (E Mag-May.) 3000 w.

†30070. Further Experiments for Determining the Fusibility of Fire Clays. Ill. H. O. Hoffman (Tr A M E-March.) 3000 w.

30084. The Tanning School of Saxony (Sc A S-March 16.) 700 w.

30085. The Influence of the Bicycle in Health and in Disease. Graeme M. Hammond. From the Medical Record (Sc A S-March 16.) 4500 w.

30088. The Glasgow and West of Scotland Technical College. Ill. Andrew Pinkerton (E W-March 16) 1500 w.

30110. Transverse Strength of Douglas Fir. Ill. Charles B. Wing (E N-March 14.) 900 w.

30113. Wind Pressures in Engineering Construction. W. H. Bixby (E N-March 14.) 20000 w.

*30202. The Worthlessness of Petroleum

*We supply copies of these articles. See introductory.*

Inquiries. Extract from T. Graham Young (C T J-March 9 ) 2500 w.

†30265. Improved Methods of Water Analysis. Ill. Irving A. Bachman (J A C S-April.) 1500 w.

*30352. The Composition of the Extinctive Atmospheres Produced by Flames. Frank Clowes (C G-March 15.) 1300 w.

30389. Textile Schools in this State. Editorial (B J C-March 16.) 900 w.

30405.—75 cts. Some Experiences in Engineering Practice. Ill. George Duncan (T Q-Oct., 1894.) 8400 w.

30407.—75 cts. Some Observations on the Growth of Diatoms in Surface Waters. George C. Whipple (T Q-Oct., 1894.) 4800 w.

*30414. The Transport of Frozen Meat. Anon. (Tr-March 15.) 2500 w.

30442. The Dead Liquor in Ammonia Systems. H. C. Price, with Editorial (S E-March.) 1500 w.

*30444. The Modern Theory of Representation. Lewis R. Harley (A M C-April.) 3700 w.

*30446. Patriotism. Wilmot H. Goodale (A M C-April ) 4500 w.

*30447. An Historic Legislative Crisis. Alfred E. Lee (A M C-April.) 3400 w.

*30448. Colonial Relationship to the Mother-Land. J. H. Long (A M C-April.) 2700 w.

*30449. Revision of Constitutions. William W. Phelps (A M C-April.) 1500 w.

*30450. What True Patriotism Demands of the American Citizen. Roger Sherman (A M C-April.) 2200 w.

*30451. Reform from the Farmer's Point of View. Wilbur Aldrich (A M C-April.) 3000 w.

*30454. Some Aspects of the Liquor Problem. Henry O. Ward (A M C-April.) 2000 w.

30467. The Manufacture of Porcelain. Ill. of Knowles, Taylor and Knowles Co. (Sc A-March 30.) 1100 w.

30469. Cause of the Gulf Stream and Similar Ocean Currents. John P. Whipple (Sc A-March 30.) 1200 w.

30472. Fossil Land Surfaces of the Silurian. W. R. MacDermott (Sc A S-March 30.) 1700 w.

30481. One of New York's Old Landmarks. Castle Garden. Editorial (Am S-March 28.) 450 w.

30526. The Cliff Dwellings of the Lower Verde Valley, Northern Arizona. Sharlot M. Hall (Arch-April.) 1800 w.

†30547. Niagara and the Great Lakes. Ill. Frank Bursley Taylor (A J S-April ) 6800 w.

†30567. The Stratigraphy of Northwestern Louisiana. Ill. T. Wayland Vaughan (A G-April.) 8000 w.

†30568. The Paleontologic Base of the Taconic or Lower Cambrian. N. H. Winchell (A G-April.) 1800 w.

†30569. The Missouri Lead and Zinc Deposits. James D. Robertson (A G-April.) 5000 w.

†30570. On the Wind and Sand Dikes of the White River Miocene. E. C. Case (A G-April.) 2300 w.

*30578. The Flash-Point of Burning Oils: Is It At Present Consistent with Safety? Editorial (Inv-March 16.) 2500 w.

*30585. Modelling and Carving. W. N. B. (I C B-March 22.) 1200 w.

†30639. On the Atomic Weight of Oxygen. Synthesis of Weighted Quantities of Water from Weighted Quantities of Hydrogen and of Oxygen. Edward W. Morley (A C J-April.) 2200 w.

30688. Some Remarks on "Argon." Bohuslav Brauner (Sc A S-April 6.) 1000 w.

30690 The South Pole and Its Problems. F. A. Cook (Sc A S-April 6.) 2800 w.

30691. The Cause of the Movement of Glaciers. P. L. Addison (Sc A S-April 6.) 2800 w.

*30702. Engineers of To-day—and Yesterday. James Riley. Ill. (E Rev-Feb. 20.) 1600 w.

*30705. Engineers of To-day and Yesterday. Benjamin Alfred Dobson (E Rev-March 20.) 1200 w.

30757. The Liquefaction of Gases. Charles Olszewski (E M J-April 6.) 4800 w.

†30829. Points on Tires from the Repair-shop. John Lurie (I R W-April 6.) 2000 w.

†30830. Temperature vs. Pressure During Vulcanization. A. B. Hohmann (I R W-April 10.) 900 w.

†30831. Extraction of Rubber from the Minor Plants.—An Experiment by Mr. John H. Cheever (I R W-April 10.) 1000 w.

Serials.

24462. Graphic Statics. W. W. F. Pullen (P Eng-Began Aug. 10—15 parts to date—30 cts. each).

26996. Statically Indeterminate Structures and the Principle of Least Work (E-Began Nov. 9. 1894—Ended March 15, 1895—6 parts—30 cts. each).

28427. An American Engineer's Observations in Europe. J. F. Flagg (E R-Began Jan. 12—3 parts to date—15 cts. each).

28838. The Contributions of Chemistry to the Methods of Preventing and Extinguishing Conflagrations. Thomas H. Norton (J A C S-Began Feb.—2 parts to date—45 cts. each).

29531. A History of the Last Quarter-Century in the United States. Ill. E. Benjamin Andrews (Sc M-Began March—2 parts to date—30 cts. each).

30255. The Artesian Water-Bearing Area of New South Wales. Ill. E. F. Pittman (A M S-Began Feb. 2—2 parts to date—30 cts. each).

30382. Physical Work of Hermann von Helmholtz. A. W. Rücker (N-Began March 14—Ended March 21—2 parts—30 cts. each).

30386. Electrification of Air and Other Gases by Bubbling Through Water and Other Liquids. Ill. Lord Kelvin, Magnus MacLean, and Alexander Galt (E R L-Began March 15—2 parts to date—30 cts. each).

*We supply copies of these articles. See introductory.*

# COMMENT & CRITICISM

### Gives It a Name.

[An esteemed correspondent, who desires to sign himself "Nemo" rather than use his own name in the present instance, assigning valid business reasons for this, has addressed to us the following letter.—EDITOR.]

SIR:—I went to New York on March 28 to meet an English friend just arrived from India. After the usual greetings, and after some conversation turning upon engineering progress in India, he produced a copy of *Indian Engineering* (Feb. 16), and, with a complimentary remark about the enterprise of colonial publishers and the marked ability of American writers upon engineering subjects, pointed out, as an example of both, an article signed Charles E. Emery, Ph. D., the name of an American engineer whose reputation is coextensive with the use of the steam engine throughout the civilized world.

Rather interested in the fact that Dr. Emery had become a contributor to a publication in far-away Calcutta, I glanced at the title, and, running my eye over the page, discovered, almost at once, that the article had been stolen—title, signature, and text in full—from THE ENGINEERING MAGAZINE for last January, being the first of two excellent papers in a mechanical series which had, as I have means of knowing, been purchased, paid for, and copyrighted by THE ENGINEERING MAGAZINE CO.

I handed the paper back to my friend with the remark that thieves on both sides of the globe are an enterprising lot, and that, for the most part, they are able to pick out the best quality of goods from the stock they are looting. I also asked him how he thought that other eminent engineer, Sir Robert Rawlinson, K. C. B., president of the honorable Institution of Civil Engineers, whose portrait is printed on the page opposite the title of Dr. Emery's article, would like to know that his picture was employed to embellish an assortment of stolen goods exposed for sale by the robbers that purloined them.

There cannot be the least doubt that the article was deliberately and with full intent stolen by the publishers of *Indian Engineering*, because this publication is included in the list of your regular exchanges,—page 696 of the same number in which Dr. Emery's article appeared. The style in which the article is printed without any credit to THE ENGINEERING MAGAZINE, as well as the fact previously mentioned, indicates the intent to steal. A further indication is that it is marked (I), which shows also the intention to steal (II).

I can speak for myself, and feel sure I might speak for Dr. Emery and Sir Robert Rawlinson as well as every member of the numerous engineering societies and associations in both hemispheres, that such courses are not regarded honest in the profession. While the genus *thief* of the grand order *Robber* contains numerous varieties, it has been agreed by all moralists that its distinguishing trait is the habit of taking surreptitiously what belongs to others.

NEMO.

*Boston, April* 30, 1895.

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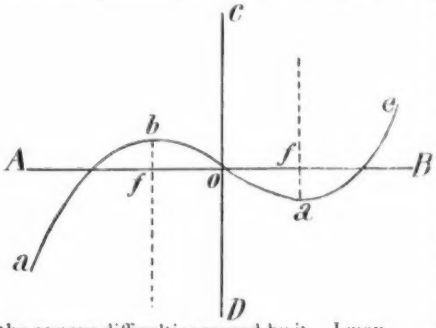
### Anchor Ice.

REFERRING to the review on page 115, current volume, I wish to remark that, while ice under certain conditions will float in water, it is equally true that under certain other conditions it will sink. While the floating presents nothing unaccountable, no intelligent explanation of the sinking of ice has been supplied.

To my mind this fact is really amazing. Year after year I have been tempted to tell the truth, the whole truth, about this matter, but it seemed so absurd to assume the instruction of an educated class of men upon a matter in their own line, and rather out of my line, that my natural modesty has restrained my pen.

The article on this subject in your April number sets forth many of the curious facts and phenomena of anchor ice, and




the serious difficulties caused by it. I may also remark that much that Mr. T. C. Keefer is represented as saying should have been credited to Mr. Desmond Fitzgerald of Brookline, including the steam blow-out device for breaking up masses of ice at a gate-house.

It is both entertaining and instructive to examine such testimony, and much more could be presented. I shall not, however, attempt to assemble and analyze the various facts and theories relating to anchor ice which have come to my notice during several years, but will pass at once to an explanation and a remedy.

Ice contracts from 24° F., up or down, and below 16° F. it will sink in water at 32° F. or at 48° F.; also below 8° F. ice will sink in water at 40° F. Most bodies in nature expand when heated, and contract when cooled. The volume of solids varies but little through difference in temperature; the volume of liquids varies more from the same cause.

There is a very singular fact connected with the expansion and contraction of substances at and near the temperature of fusion, which may be illustrated by the accompanying figure;

Let *A B* represent the abscissa axis of temperature, *C D* the ordinate axis of expansion or contraction, the origin *O* the temperature of fusion, *O A* the temperature of the solid, and *O B* that of the liquid.

Let a solid of volume and temperature at *a* be heated; it will expand until it reaches a maximum volume at *b*, after which it contracts toward the temperature of fusion *o*. The temperature still increasing, the liquid will contract until it reaches a minimum volume or maximum density at *a*, after which it will expand toward *e*. The lines *a*, *b*, *o* and *o*, *a*, *e*, are parabolas, of which the axis of abcissas *A B* passes through the foci *f*. The formula for the parabola is $y = x^n$, in which the exponent *n* depends upon the nature of the substance, and also upon whether it is linear or volume expansion, *x* representing the temperature and *y* the volume.

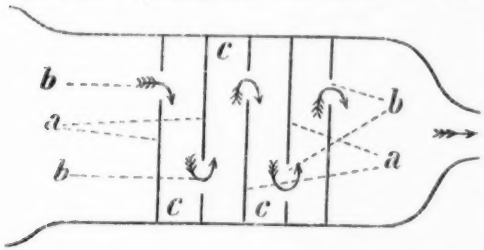
Ice melts at 32° F., and the water reaches its maximum density at *a*, 40° F. Ice reaches a maximum volume at *b*, 24° F. Ice and water are of equal density at 16° F., 32° F., and 48° F. Ice generally floats in water because the difference in temperature is less than 16 degrees; but, as above stated, if ice of less then 16° is put in water at 32°, or 48°, or more, it will sink. The same phenomena is observed in other substances. For instance, solid cast-iron will float in molten cast-iron; but, if the fluid cast-iron be at a white heat, as in a pneumatic furnace, the solid cast-iron will sink.

From a consideration of these facts it is evident that, if a sufficiently cold wave descends upon an open body of water, the ice crystals will sink as they form. If the water be warm, the crystals will wholly remelt. If the water is at a 32° F. saturation, the results are serious. A movement of the air aggravates the case, since a necessary result is the more rapid removal of heat from the water.

The "anchoring" of the ice is due to the fact that, if a foreign solid body is introduced within a crystallizing medium, it disturbs the "balance," so to speak; and, as the operation can take place in but one direction, the solid body becomes the core or root from which the growth proceeds. Hence, if the bed or shore of a pond or river, or wood or iron work about a gate-house, are at a sufficiently low temperature, the ice attaches itself thereto, while the fact of their being at rest favors a rapid growth. Once anchored, it re-

mains until destroyed by heat or violence.

The proper method of guarding a gate or other outlet is shown in Fig. 2, in which *a a* are deflecting dams or jetties, *b b* ports therein, and *c c* pockets into which the ice




is projected by the current, precisely as water and oil are separated from steam by the inertia of the moving particles. This arrangement, with Mr. Fitzgerald's steam pipe blow-out at the gate or turbine, will solve the difficulty.

FRANK S. MASON.

*Malden, Mass., April* 8, 1895.

### Hydraulic Engineering,

IN connection with your recent remarks on Indexes (January '95 issue) it may be of interest to you to know that I have here a Card Index of Hydraulic Engineering, which now contains over 8000 cards and includes both *book* and periodical literature.

Also a "Topical" Index of the subjects, without references in dictionary form, giving the *subjects* or headings in alphabetic order, with cross references, and an analysis of each important heading as under Canals, Rivers, Water Supply, etc. The latter now covers about 30 pages of typewritten foolscap, and is growing.

I am willing and anxious to make this index of general use, and would be glad to coöperate with anyone in any desirable way. It will give me pleasure also to show the index at any time or describe my work in this connection in detail.

GEORGE D. COLTON.

Collinsville, Conn., April, '95.

## BOOKS RECEIVED.

Carl K. MacFadden, Associate Member American Institute Electrical Engineers; William D. Ray, Associate Member American Institute Electrical Engineers, Vice President Chicago Electrical Association.=The Practical Application of Dynamo Electric Machinery. (Second Edition.) Revised. Chicago: Date & Rubbles, 1894. [167 pp., 5⅞×4". Cloth, flexible, Price $1.00.]

Third Annual Report of the Railroad Commission of the State of Texas, for the Year 1894. Austin, Texas: Ben C. Jones & Co., State Printers, 1895. [282 pp., 6"×9", paper.]

Arthur Kitson.=A Scientific Solution of the Money Question. Arena Library Series. Boston: Arena Publishing Co., 1895. [418 pp., 7¼"×5¼". Cloth, price $1.25; paper, 50 cts.]

Summary Statement of the Imports and Exports of the United States for December, 1894. Corrected to Feb. 1, 1895. With comparative tables and general statistical information. Prepared in the Bureau of Statistics, Treasury Department, Washington, 1895. [pp. 583-673, 9"×11¾". Paper.]

Annual Report of the Chief of the Bureau of Statistics upon the Foreign Commerce of the United States for the year ending June 30, 1893. Washington: Government Printing Office, 1893. [158 pp., 8½"×11". Cloth.]

Imported Merchandise Entered for Consumption in the United States during the years 1890-93, with Rates and Amounts of Duty Collected. Prepared in the Bureau of Statistics, Treasury Department, for the Committee of Ways and Means of the House of Representatives. Washington: Government Printing Office, 1893. [163 pp., 9"×11".]

Austin T. Byrne, Ingeniero Civil.=Sistemas Modernos de Alcantarillado y Neutralizacion de las Materias Nocivas Y Excrementicias en las poblacicione s; con referencia especial à los sistemas más adecuados á las condiciones topográficas de la Ciudad de la Habana Y Metodos Modernos Para Pavimentar Calles con referencia especial á las condiciones de la citada ciudad de la Habana. Habana: La Propaganda Literaria, (Premiada en varias Exposiciones) Imprenta-Estereotipia-Galvanoplastia-Librería-Papelería. Zulueta 28, entre Virtudes y Animas, 1894. [72 pp., 6"×8½", with maps and folding plates.]

Interstate Commerce Commission.=Preliminary Report on the Income Account of Railways in the United States for the year ending June 30, 1894. Prepared by the Statistician to the Commission. Washington: Government Printing Office, 1894. [59 pp., 6"×9", paper.]

Statistical Abstract of the United States, 1889. 12th number. Finance, Coinage, Commerce, Immigration, Shipping, the Postal Service, Population, Railroads, Agriculture, &c. Prepared by the Bureau of Statistics under the direction of the Secretary of the Treasury. Washington: Government Printing Office, 1890. [314 pp., 5¾"×9", paper.]

*For further books received see page 401.*

# NEW BOOKS OF THE MONTH

THE ELECTRICIANS' ELECTRICAL TRADES DIRECTORY and Handbook for 1895. London: The Electrician, 1895. [907 CXX pp., 9″×6″, cloth, Price, 8s., 10d.]

THE handbook division of this directory contains an almanac and calendars, with dates and events of interest to the electrical world; a summary of electrical events for 1894, including obituary notices; information relating to patents, designs, and trade-marks; a digest of the civil laws relating to electric lighting and electric traction; board of trade lighting regulations up to date; London county council by-laws relating to overhead-wires and regulations as to theatre lighting; electric light and power regulations by other local authorities; rules and regulations for the prevention of fire risks arising from electric lighting (British and foreign); electric supply companies' installation regulations; electric lighting and electric traction notices for 1895; provisional orders granted by the board of trade in 1894; companies registered and companies wound up in 1894; detail statistics of central electric-lighting stations, electric railways, and tramways in the United Kingdom; electric standards from the order in council respecting the imperial ohm, ampere, and volt; rules for dealing with cases of apparent death from electric shocks; colonial and foreign import duties; post-office regulations, etc., etc. With numerous useful tables. The pages numbered in Roman notation include biographical sketches of famous electricians.

TRANSACTIONS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Volume XV, 1894. New York: Published by the Society from the Library Building, No. 12 West 31st St [1359 pp., 6″ × 10″.]

THIS volume, made up of selected papers read before the society, contains a vast amount of discussion upon mechanical engineering in all its various phases, which renders the book extremely desirable for public and private libraries. Many illustrations and plates are employed in elucidating the papers and discussions, and the most cursory examination of the contents is sufficient to show that no working society of engineering either in this country or abroad is doing more earnest and good work than The American Society of Mechanical Engineers.

THE TELEGRAPH. TRANSLATED FROM THE FRENCH OF A. L. Ternant, by R. Routledge, B.Sc., F.C.S. With 136 illustrations. London, Manchester; New York: George Routledge & Sons, Ltd., 1895. [289 pp., 5″ × 7″. Price $1.50.]

THE first part of this book describes, illustrates, and discusses the principle of optical, acoustic and pneumatic telegraphy. Probably few are aware to what an extent light, sound, and air have been employed in the transmission of signals to distant stations. This book will acquaint them with the history of these kinds of telegraphy and the present state of the art. The second part deals historically, practically, and scientifically with electrical telegraphy. An interesting feature of the book is the portraits of men who have distinguished themselves in land and sub-marine telegraphy. Some of the illustrations are not strictly technical, but serve to give to the common reader an idea of the various operations involved in the practice of the art. The translation appears to have been very well executed.

A TEXT-BOOK OF STATICS. BY WILLIAM BROOKS, M. A., LL. B., R. A. S., general editor of the Tutorial Series, Principal of University Correspondents' College, and G. H. Bryan, M. A., Smith's Prizeman, Fellow of St. Peter's College, Cambridge. New York: W. B. Clyde, 1895. [220 pp., 7″ × 4¼″. Price, 40c.]

AN elementary course of statics is here supplied, which excludes those facts of the science requiring a knowledge of trigonometry on the part of the student. An effort has been made to lessen the difficulties usually encountered by beginners, here foreseen by the authors, who are experienced instructors in statics and dynamics. This purpose is accomplished by hints and explanations, which, without removing the necessity of mental effort, direct the

pupil's mind unconsciously to himself toward the intellectual point of compass where lies the truth he seeks. One of the best features of the book is the profusion of examples to be worked out. The solving of such examples will impress the principles of statics upon the memory more than any other exercise. The examples are framed with a skill that can come only by experience in teaching.

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A TEXT-BOOK OF DYNAMICS. By WILLIAM BROOKS, M. A., LL. B., F. R. A. S., General editor of the Tutorial Series, principal of University Correspondents' College; and G. H. Bryan M. A., Smith's Prizeman Fellow of St. Peter's College, Cambridge. New York: W. B. Clyde, 1895. [192 and XIV pp., 5″×6¼″, cloth. Price, 50c.]

WHAT has been said above of the treatise on statics by the same authors is equally applicable to this elementary course of dynamics. Here, however, avoidance of some use of trigonometrical notation was impossible, even in an elementary treatise. A chapter on trigonometry, however, supplies as much of this branch of mathematics as is needed for the purposes of the work. The subject of dynamics presents to beginners greater difficulties than statics. Experimental illustrations are frequently used to aid in the mastery of the intricacies of the laws of motion. The examples for practice show the same evidence of skill and experience in teaching as those in the works on statics.

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ELEMENTS OF PHYSICS FOR USE IN SECONDARY Schools. By S. P. Meads, Oakland High School, Oakland, California. New York, Boston and Chicago: Burdette & Co., 1895. [288 pp., 5″×7″, cloth. Price, 72c.]

AS an introduction to experimental physics, Mr. Meads has here supplied a very good text-book. A notable feature is the selection of typical experiments illustrating each principle enunciated, with ample instructions for its successful performance, and these selections have been specially adapted to the average ability of the grade of pupils for which the book has been prepared.

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EVOLUTION AND ETHICS, AND OTHER ESSAYS. By Thomas H. Huxley. New York: D. Appleton & Co., 1894. [334 pp., 5″×7″. Price $1.25.]

THIS is the ninth volume which has been published under the heading of "Collected essays" written by Professor T. H. Huxley and published by D. Appleton & Co. All who are familiar with the writings of Professor Huxley will expect to find it a very readable book, and they will not be disappointed. The chapter on "Social Diseases and Worse Remedies" comprises Prof. Huxley's letters to the *Times* on Gen. Booth's scheme of the Salvation Army; and, while according to Mr. Booth pure motives, points out inherent dangers that exist in the organization, which requires of its officers as absolute obedience to Gen. Booth as Jesuits are compelled to render to their superiors. In the first chapter, entitled "Prolegomena," the author shows that the state of civilized nature is, in a sense, hostile to natural conditions, illustrating it by the cultivation of a garden in which weeds that would otherwise destroy the cultivated plants are eliminated. It is therefore logically concluded that the present tendency towards individualism is retrograde rather than in the line of progress.

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THE ELEMENTARY PRINCIPLES OF MECHANICS. VOLUME I: Kinematics. Volume II: Statics. By A. J. DuBois, C.E., Ph. D., Professor of Civil Engineering in the Sheffield Scientific School of Yale University, Author of "Elements of Graphical Statics," "The Strains in Framed Structures," etc. First Edition. New York: John Wiley & Sons, 1894. Volume I. [231 pp., 5¾″ × 9″. Price $4.00.] Volume II. [392 pp., 5¾″ × 9″. Price $4.00.]

FIRST-RATE text-books in every particular for which exacting criticism can demand excellence. The definitions are clear and accurate. The methods and arrangement are admirable. Prepared by a thorough master of the subject, an accomplished scholar and an experienced instructor, all the difficulties of the subject are approached on the line of least resistance. The student, properly prepared in his mathematics, who studies either the subject of kinematics or statics from these volumes will find in them so much of the kind of help he needs as to render the assistance of a living teacher almost unnecessary.

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## BOOKS RECEIVED.

Irrigation in Utah. Published by direction of the Utah Irrigation Commission. [128 pp., 5¾ ×8¾″, paper.]

Wynkoop Kiersted, Member A. M. Soc. C. E.=Determination of the Proper Size of the Supply Main for the new Water Supply of Galveston, Texas. Reprinted from selected papers of Rensselaer Society of Engineers, January, 1894. Troy, New York: E. H. Lisk, 1894. [12 pp., 6″×9″, paper.]

Statistical Abstract of the United States, first number, 1878. Finance, Coinage, Commerce, Immigration, Shipping, the Postal Service, Populations, Railroads, Agriculture, Coal and Iron. Prepared by the Chief of the Bureau of Statistics, Treasury Department. Washington: Government Printing Office, 1879. [157 pp., 5¾″×9″, paper.]

Statistical Abstract of the United States, 1885. Seventh and eighth numbers. Finance, Coinage, Commerce, Immigration, Shipping, the Postal Service, Population, Railroads, Agriculture, &c. Prepared in the Bureau of Statistics under the direction of the Secretary of the Treasury. Washington: Government Printing Office, 1886. [205 pp., 5¾″×9″, paper.]

Statistical tables exhibiting the commerce of the United States with European countries, from 1790 to 1890. Prepared by the Chief of the Bureau of Statistics, Treasury Department. Washington: Government Printing Office, 1893. [460 pp., 5½″×9″, cloth.]

W. L. Derr, New York Railroad Club.=Notes on appliances and methods of clearing up railroad wrecks. Meeting of January 17, 1895. Also contains copy of the new constitution and by-laws, and a list of the members, published by the club. John A. Hill, Secretary, 256 Broadway, New York, 1895. [54 pp., 6″×9″, paper.]

Proceedings of the Fourth annual meeting of the American International Association of Railway Superintendents of Bridges and Buildings, held in Kansas City, Mo., Oct. 16, 17, and 18, 1894. Printed by the Republican Press Association, Concord, N. H., 1895. [104 pp., 6″×9″, paper.]

City of Cambridge, Park Department.=Annual Reports for the year 1894. Printed for the Department. [Octavo, 120 pp., cloth.]

Dr. A. Scheidel, E. M. California State Mining Bureau, J. J. Crawford, State Mineralogist=Bulletin No. 5. San Francisco, October, 1894. The Cyanid Process, its Practical Application and Economical Results. Sacramento: A. J. Johnston, Supt. State Printing, 1894.

Third Report of the Bureau of Mines, 1893.=Printed by order of the Legislative Assembly of Ontario. Toronto: Werwick Bros. & Rutter, Printers, 1894. [8vo., 205 pp., flexible covers.]

W. G. Hopper, author of "English Pen Artists of the Day."=A Practical Handbook of Drawing for Modern Methods of Reproduction. Illustrated with drawings by several hands and with sketches by the author, showing comparative results obtained by the several methods of re-production now in use. London: Chapman & Hall, Ltd.; Philadelphia: J. B. Lippincott Co., 1894. [161 pp., 5½″×8½″, cloth, price $2.50.]

New York Railroad Club, L. R. Pomeroy.=Steel Axles. Being a paper read before the New York Railroad Club December 20, 1894. New York: Published by the Club, 256 Broadway. [Pamphlet, 31 pp., 6″×9″.]

W. Kiersted and Dr. T. M. Drown.=Reports on the New Water Supply for the City of Galveston, Texas, in 1892 and 1893. Kansas City, Mo.: Tew Lyle Printing Co., 1893. [Pamphlet, 19 pp., 6″×9″.]

The Cornell University, Rochester, 1894-95. Ithaca, N. Y.: University Press of Andrews & Church, 1895. [Flexible cover, 278 pp., 5″×7½″.]

James Bell, A. I. E. E.=The Telegraphists' Guide to the New Examinations in Technical Telegraphy. London: "Electricity," 1895. [101 pp., 7″×4¾″, flexible covers.]

Charles H. Sanders, Ph. B.=Handbook of Practical Mechanics for Use in the Shop and Draughting. Containing tables, rules, and formulas, and solutions of practical problems by simple and quick methods. Hartford: Student Publishing Co., 1895. [116 pp., 6″×4″.]

G. S. Turpin, M. A. (Camb.), D. Sc. (London), Principal of the Technical School, Huddersfield.=Lessons in Organic Chemistry, Part I. Elementary. New York: MacMillan & Co., 1894. [140 pp., 4¾″×6¾″, cloth, price $0.75.]

Report of the Massachusetts State Board of Health upon a Metropolitan Water Supply. Boston: Wright & Potter, State Printers, 1895. [233 pp., 9″×5¾″, cloth.]

Wilfred J. Lineham, head of the engineering department at the Goldsmith's Company Institute, New Cross; late professor of engineering at the School of Science and Art and Technical College, Newcastle-on-Tyne, member of the Institute of Mechanical Engineers of the North-east Coast, Institute of Engineers and Ship Builders, Society of Arts, &c.=A Text-Book of Mechanical Engineering; Part I, Workshop Practice; Part II, Theory and Examples. London: Chapman and Hall, Limited, 1894. [772 pp., 8″×5″, cloth.]

Twenty-fifth Annual Report of the State Board of Health, Massachusetts. Boston: Wright & Potter Printing Co., State Printers, 1894. [812 pp., 9″×6″, paper.]

David L. Day, chief of division of mining statistics and technology, department of the interior, United States Geological Survey, J. W. Powell, director.=Mineral Resources of the United States, calendar year 1893. Washington: Government Printing Office, 1894. [810 pp., 6″×9″, cloth.]

Second Report of the Bureau of Mines, 1892. Printed by order of the legislative assembly of Ontario. Toronto: Warwick & Sons, 1893. [263 pp., 6″×9″, with an appendix, "The Mines Act of 1892," 35 pp., half calf.]

Edmund B. Kirby.=The Sampling and Measurement of Ore Bodies in Mine examinations. Read before the Colorado Scientific Society, Denver, December 3, 1894. [Pamphlet 25 pp., 9″×6″ and 1 folding plate.]

Annual Report of the City Engineer of the City of Omaha, December 31st, 1894. Omaha: Klopp & Bartlett Co., 1895. [51 pp., 9″×6″, and 12 large folding plates, paper.]

Joseph Edwards.=Labor Annual, 1895. A Year-Book of Industrial Progress and Social Welfare. Second Edition, revised and enlarged. Manchester: Labor Press Society, Ltd. [234 pp., 7¼″×4¾″, paper, price 1 shilling.]

Reginald Bold, past president of the Civil and Mechanical Engineers' Society, associate member of the Institution of Civil Engineers, and member of the London Chamber of Commerce. =Motive Powers and Their Practical Selection. New York. Longman, Green & Co. [227 pp., 7½″×8″, cloth, price $2 25.]

Report of the City of Baltimore Topographic Survey to the Mayor and City Council of Baltimore, for the fiscal year ending December 31, 1894. Baltimore: William J. C. DuLemy, City Printer, 1895. [220 pp., 9″×5¾″ and 8 large folding plates.]

Henry L. Call.=The Coming Revolution. Boston: Arena Publishing Co., 1895. [239 pp., 7½″×¾″.]

Charles Day, Wh. Sc. of the National Boiler Insurance Co, Manchester.=Indicator diagrams and engine and boiler testing. Manchester: Technical Publishing Co., Ltd., 1895. [205 pp, 7″×4¾″, cloth.]

George William Sutcliffe, Whitworth Scholar, member Institution Civil Engineers. = Steam Power and Mill Work. Principles of Modern Practice. London: Whittaker & Co., 1895; New York: McMillan & Co., 1895. [886 pp., 7¼″×5″, cloth, $4.50 ]

Report of the Commissioner of Education for the year 1891-92. Washington: Government Printing Office, 1894. [1294 pp., 9″×5¾″.]

William C. Stubbs, Ph. D., Director of Louisiana State Experimental Stations.=A Handbook of Louisiana, giving geographical and agricultural features, together with crops that can be grown, description of each parish, climate, health, education, fish and oysters, railroads, water courses, compiled and written by request for the State Immigration Association. New Orleans. Free on application to the State Immigration Association, 620 Common Street, New Orleans, La. [56 pp., 9″×5½″, paper.]

I. McKim Chase, M. E.=Screw Propellers and Marine Propulsion. First Edition. New York: John Wiley & Co., 1895. [230 pp., 6″×9¼″, cloth, price $3.00.]

Ernest McCullough, C. E., member of the Technical Society of the Pacific Coast.=Public Works. A Treatise on Subjects of Interest to Municipal Officers. First Edition. 1894. [54 pp., 9″×6″, paper, price $.25. For sale by the author, 511 California Street, San Francisco, Calif.]

Henry Gannett, chief geographer of the Geological Survey and of the tenth and eleventh censuses. = The Building of a Nation. The Growth, Present Condition, and Resources of the United States, with a Forecast of the Future. Illustrated with maps, charts, and diagrams. New York: Henry T. Thomas Co., 1895. [252 pp., 5½″×8½″, cloth.]

George Martin Huss, member Architectural League of New York.=Rational Building. Being a translation of the article, "Construction" in the Dictionnaire Raisonné de 'l Architecture Française of M. Eugéne-Emmanuel Viollet-le-Duc. New York and London: MacMillan & Co., 1895. [367 pp., 8¾″×6″, cloth, price $3.00.]

George F. Swain, Ira C. Baker, J. B. Johnson, editors. = Engineering Education. Proceedings of the Second Annual Meeting of the Society for the Promotion of Engineering Education, held in Brooklyn, New York, August 20-22, 1894, in conjunction with the American Association for the Advancement of Science. Vol. 2. [292 pp., 8½″×6″, cloth, Price $2.50, post paid. Copies may be obtained of J. B. Johnson, secretary of the Society for the Promotion of Engineering Education, Washington University, St. Louis.]

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## NEW TRADE CATALOGUES.

*These catalogues may be had free of charge on application to the manufacturer.*

The Q. & C. Co., Chicago, Ill., U. S. A.= Catalogue, 26 pp., 9″×6″. [Describes and illustrates railway specialties and special machinery, including a line of car doors adapted to different purposes, the Q. & C. shop saws, globe ventilators, die plates, Bryant metal saw, Q. & C. wrecking frog, Q. & C. cattle guard, standard cattle guard, McKee brake adjuster, etc.]

The Goulds Manufacturing Co., Seneca Falls, N. Y., U. S. A.=Catalogue, 429 pp., 7″×7″. [Describes and illustrates, with price lists, pumps and hydraulic machinery for every service, pump supplies, well tools, &c. A notable feature of the book is its classified arrangement, all the appliances of the same class being grouped together. The book is thoroughly indexed, and each group is named in a table of contents. Evidently a great deal of labor has been expended in preparing this exhaustive list. Cover, cloth, black and gold.]

J. B. Prescott & Son, Webster, Mass., U. S. A.=Catalogue, 32 pp., 6″×9″. [Describes and illustrates the Morse patent steel and iron ties for bonding hollow and veneer walls, terra cotta work, face brick ashlar, etc.]

The Central Press Brick Co., Cleveland, Ohio, U. S. A.=53 leaflets, 9″×5½″, printed on one side only, and eyeleted and tied together with robin's-egg blue cover. [Describes and illustrates a line of brick mantels, with a view to giving an idea to the public of the possibilities that can be obtained from the artistic use of pressed brick. Many of the illustrations are printed in colors, and the entire collection of samples is extremely elegant. It is stated that the samples contained in these leaflets are only a few of the many styles manufactured by the company.]

Walburn Swenson Co., Chicago, Ill., U. S. A. =Catalogue, 48 pp., 9″×6″. [Describes and illustrates the ore-dressing machinery manufactured by this company, and also complete plants for concentration of low-grade ores. Also describes coal washing machinery. Four pages of testimonials are presented; also a table of specific gravities of minerals, metals, and alloys. An interesting description of a concentrating plant built for M. Guggenheim's Sons, New York, for their works in Mexico, is a feature of this catalogue.]

The Dececo Company, Boston, Mass., U. S. A.=(1) Catalogue, 11 pp., 9″×11¾″. [Describes and illustrates improved plumbing app'iances, lavatory combinations, &c., with price lists.]

(2) Catalogue, 12 pp., 9″×11¾″. [Describes improved water closet combinations manufactured by this company, with other plumbing appliances.]

(3) Catalogue, 31 pp., 9″×11¾″. [Describes and illustrates a line of bath tubs and fixtures. The catalogues are also supplied with a neat file for binding.]

Fred Adee & Co., New York, U. S. A.= Catalogue, 122 pp., 6″×4″. [Describes an entire line of plumbing goods, and sanitary specialties manufactured by this firm, with price lists of the same.]

The Brewer Pottery Co., Tiffin, Ohio, U. S. A.=(1) Catalogue, 60 pp., 5½″×6½″. [Describes and illustrates a line of siphon closets, washouts, pedestals, combined hoppers and traps, plain and embossed urinals, embossed basins, plumbers' vitreous china, &c. Beautifully printed on coated paper, with pink and gold cover.]

(2) Leaflet, 12 pp., 3¼″×5″. [Answers the questions frequently asked by plumbers: 1. "What causes so much crazage in earthenware?" 2. "Why do so many horns break off?" 3. "Why do earthenware closets become foul?" 4. "What causes a closet to crumble?"]

Nicholson File Co., Providence, R. I., U. S. A., 1894.=Illustrations of files, rasps, and tools. 60 pp., 14″×11″. [Contains also a description of the Nicholson File Company and its founder, William Nicholson, with views of the factories and offices of the works, World's Fair exhibit at Chicago, general information, and price lists. An elegant publication, printed on white paper with green edges, and bound in dark blue and silver covers.]

Fraser & Chalmers Chicago Ill. U. S. A.= (1) Catalogue No. 19, 2d Edition, Code word "Aspillerar." The Pelton Water Wheel. 61 pp., 9″ × 6″. [Describes the Pelton system of power, with the various styles of Pelton water wheels with general information as to hydraulic pipe water measurement, water power hoists, water wheels for high heads, air compression by water power, the Riedler air compressors and pumps, hydraulic nozzles and giants, with numerous tables for hydraulic calculations, &c.]

(2) Publication No. 29, 3d edition, Code word "Aspiraron." Fraser & Chalmers Library. Pamphlet, 47 pp., 9″ × 6″. [Discusses losses in gold amalgamation, with notes on the concentration of gold and silver ores. Written by Walter McDermott and P. W. Duffield. Special edition for complimentary distribution.]

(3) Catalogue No. 32. No. 32—Second Edition. 30 pp., 9″ × 6″. Ore Sampling Machinery. [Describes and illustrates H. L. Bridgman's ore sampling machines and apparatus for mixing and dividing ore samples.]

Buffalo Forge Co., Buffalo, New York, U. S. A.=(1) Leaflet, 8 pp., 7″×6¼″. [Describes and illustrates the "Buffalo" blacksmiths' drills and blowers.] (2) Leaflet, 4 pp. [Describes and illustrates the "Buffalo" tire upsetter. The Buffalo Forge Co. states that at great expense it maintains an up-to-date list of the blacksmiths of America, which it believes to be the most complete ever compiled, and that it makes a practice of sending literature of the kind named to each person on this list several times each season.]

D'Amour & Littledale, New York, U. S. A.= Catalogue, 15 pp., 6″×3⅜″. [Describes and illustrates the different varieties of "Sensitive" drills manufactured by this house.]

The Holly Manufacturing Co., Lockport, New York, U. S. A.=Catalogue, 79 pp., 10¾″ ×14″. [Describes and illustrates a great variety of horizontal, vertical, compound, and triple expansion and water-power pumps. Most of the engravings are full-page illustrations. The catalogue is printed on coated paper of fine quality. Cover, mulberry and gold, producing a very striking and beautiful effect.]

The Anchor Post Co., New York, U. S. A.= Catalogue, 21 pp., 6½″×3½″. [Describes and illustrates various styles of anchored posts for fences. Cover gray-green, printed with olive-green, producing a very delicate and neat effect.]

The Mason Electric Co., Racine, Wis., U. S. A.=Leaflet, 8 pp., 6″×3″. [Describes and illustrates the construction and operation of the Tracy patent oil filter.]

Oneida Community, Limited, Kenwood, New York, U. S. A.=Catalogue, 62 pp., 6¾″×8¾″. [Containing description and price list of animal traps, American chains, and Oneida steel wire chains.]

The Foster Engineering Co., Newark, N. J., U. S. A.=Pamphlet, 44 pp., 4¾″×6¾″. [Describes and illustrates a variety of pressure regulators and reducing valves. The pamphlet is entitled, "Facts Worth Knowing about Pressure Regulators, Reducing Valves and Pump Governors." Very nicely printed. Cover, French gray and indigo blue.]

Portland Stone Ware Co., Winslow & Co., Proprietors, Boston, Mass., U. S. A.=Catalogue, 60 pp., 4″×8″. [Describes and illustrates a great variety of fire-brick tiles, terra cotta vases, flue linings, chimney tops, cross straps, stone ware, &c. Cover scarlet and silver.]

Packard Electric Co., Warren, Ohio, U. S. A. =Catalogue, 23 p. [The Packard Transformer. Various sizes up to 300 lights. Full description and directions.]

*For additional catalogues see page 38 following Improved Machinery.*